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AIRBORNE WARNING AND CONTROL SYSTEM (AWACS) INTELLIGENT TUTORING SYSTEM (ITS)

David R. Strome

Systems Research Laboratories, Incorporated
2800 Indian Ripple Road
Dayton, OH 45440-3696

ARMSTRONG LABORATORY

HUMAN RESOURCES DIRECTORATE
TECHNICAL TRAINING RESEARCH DIVISION
7909 Lindbergh Drive
Brooks Air Force Base, TX 78235-5352

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David R. Strome

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Systems Research Laboratories, Incorporated
2800 Indian Ripple Road
Dayton, OH 45440-3696

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The Intelligent Training Branch of the Armstrong Laboratory supports and conducts research in intelligent tutoring systems (ITSs). The purpose of this project was to apply this technology in the construction of an ITS which applied to Air Force Specialty Code (AFSC) 17XX, Air Weapons Personnel. The specific domain included task conducted on the E-3B/C Airborne Warning and Control System (AWACS) aircraft. Results indicated the need for further development of the applicable software, but also indicated the plausibility for this type training in the selected domain.

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AIRBORNE WARNING AND CONTROL SYSTEM (AWACS) INTELLIGENT TUTORING SYSTEM (ITS)

Background

The United States Air Force (USAF) at Tinker AFB, Oklahoma, trains USAF officers to fulfill the role of Weapons Directors (WDs) aboard the E-3B/C Airborne Warning and Control System (AWACS) aircraft. The AWACS platform supports Command, Control and Communications (C^3) missions in the airborne environment. USAF Armstrong Laboratory, Crew Technology Division, Sustained Operations Branch (AL/CFTO), in cooperation with Systems Research Laboratories, Inc. (SRL), configured WD crewstations and affiliated systems in the Aircrew Evaluation Sustained Operations Performance (AESOP) facility to run defensive counter air (DCA) mission simulations. Teams of three WDs detect, identify, intercept, and destroy enemy aircraft attempting to attack friendly forces or penetrate friendly airspace. A Senior Director (SD) serves as the immediate supervisor in the chain of command. In a DCA mission, the SD oversees and coordinates WD efforts to execute the directives of the senior battle staff.

In cooperation with the Technical Training Research Division, Human Resources Directorate (AL/HRT), SRL began research and development of an Intelligent Tutoring System (ITS) in the Air Force Specialty Code (AFSC) 17XX C^3 domain. The effort was to provide a proof of concept, with recommendations for future development.

Developing Criteria

One of the first tasks involved narrowing the instructional domain. The following criteria were established:

1. The domain was restricted to that of weapons controllers: WDs, SDs, Weapons Controllers (WCs), and Weapons Assignment Officers (WAOs).

2. Due to practical limitations on equipment and funds, interactive voice communications were not included.

3. The domain included areas that would fill an immediate need of the Air Force's 17XX operational training community.

4. The domain was limited in order to accomplish development in the time available.

5. The ITS was restricted to Initial Qualification Training (IQT). By focusing on initial training, changes in performance would be more dramatic and therefore easier to measure.

6. Finally, in order for the ITS to teach something more than a routine procedure, we wanted to incorporate some decision-making skills.

Using these criteria, training systems at Tyndall AFB and Tinker AFB were deemed appropriate for adapting to an ITS. At Tyndall AFB, all 17XXs receive their initial Air Force training in the weapons controller career field. After graduating from Tyndall's introductory course, some 17XXs continue to Tinker for initial WD training in AWACS.

After initial contacts with training sites, we chose to focus on Tinker's AWACS community. After a fact-finding trip to Tinker (11-13 August 1991), the main subject area for initial development was identified as *Block I, AWACS WD Initial Qualification Training.* This subject area is taught at Tinker in the mission simulations. It is an introduction to the switch actions a WD uses in performance of job tasks. Block I IQT met the first five criteria for narrowing down the domain for developing an ITS. In addition, the Director of Operations of the 552 Tactical Training Squadron indicated that an ITS for this instructional block would widen a traditional training bottleneck for AWACS WD training, thus fulfilling criterion # 3.

Criterion # 6, decision-making skills, was not met. However this criterion was of a lower priority for two reasons. First, only Block I IQT WD instructional materials were set and the AWACS WD training program was being rewritten to take into account lessons learned from Desert Shield/Storm. Second, there is an ongoing reorganization by the Air Force in the training of 17XXs.

Preparation

While at Tinker, SRL tried to ascertain how Instructor WDs (IWDs) taught and evaluated IQT WD students--particularly as related to Block I IQT WD training. Important findings included:

1. Time for task completion is ill-defined in early instructional blocks.

2. Number and types of errors are also ill-defined.

3. Window for task completion, while not critical at first, rapidly becomes more important than time for task completion. The size of the window remains ill-defined.

4. Fighter Weapons School is considered more important for good experience in initial categorization of student abilities and capabilities than any other prior experience.

5. Students are not accelerated through training, even if they show exceptional skill or aptitude.

6. Prior experience and training records play a part in evaluating students, but is an exception, not a rule.

7. Only some IWDs used a dual tracking task in training of Block I IQT WDs, but this technique was being institutionalized as part of the formal program. The dual tracking task consists of a single piece of symbology on a single track in an oval orbit. The student is required to keep the symbology on the track throughout the lesson and while performing the procedures. This dual tracking task is not objectively measured, but subjectively indicates to the IWD that the student WD learned the lesson well.

8. Most switch actions are taught and used for two simulations in a row and then not trained or used until a student progression test is administered.

9. Most student evaluation is subjective.

Benefits of an ITS

ITS can eliminate or ameliorate many obstacles to efficient and effective training, including those mentioned above. ITS can take full advantage of quantitative measures developed in cooperation with expert IWDs, allow individually paced escalation of complexity and volume of tasks, and implement consistent application of evaluation criteria. In addition:

- ITS allows better use of manpower by enabling an IWD to manage the training of many student WDs rather than two or three. At the same time, ITS effectively allows a one-to-one student-to-teacher ratio.

- Because of the self-paced aspect of ITS, training can proceed at a faster rate for more able or experienced students and allow less able students ample practice time and opportunities to hone their skills.

- As the need for rapid response escalates, a WD must increase the work pace. This increase can occur only where there is spare capacity. The optimum area for this increase is that of console operations. ITS can

objectively judge this spare capacity and thereby enhance WD training by developing high-performance knowledge and skills in console operations. ITS simulations can foster achievement of these skills through "consistent practice" (Regian, 1990).

- ITS allows a student WD to consistently build on recently acquired knowledge and skills rather than moving on to other tasks before these new skills are reinforced.

Designing the ITS

ITS Paradigm

The second task under this effort required the creation of a conceptual paradigm of an ITS. The five important elements that must be related to each other are:

- a Simulator,
- a Knowledge Domain,
- an Instructor Model,
- a Student Model, and
- an Intelligent Interface that links them together (Burns & Parlett, 1990).

These elements are graphically represented in Figure 1.

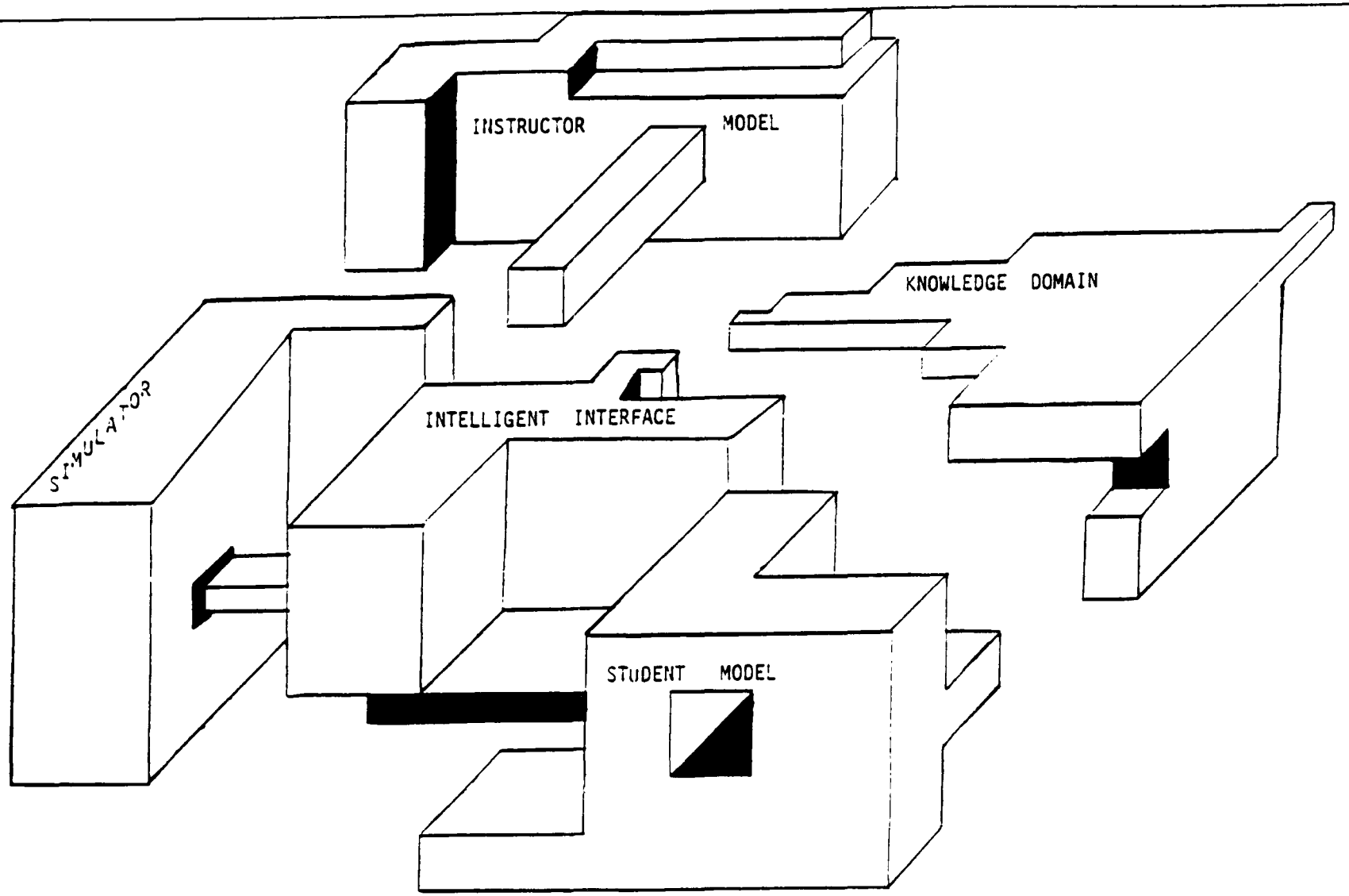

Figure 1. Intelligent Tutoring System Paradigm

Each of these five elements is interrelated to the others. A development in one element often requires a corresponding development in one or more of the other elements. In this way the different elements remain fitted together as a coherent whole. Take for example teaching the procedures for executing a *Commit* switch action. The procedural steps for executing this switch action must be included in the relevant Knowledge Domain. The Simulator must have this switch action and be able to execute it. The Instructor Model must indicate how, when, and where in the course of instruction to teach the *Commit* switch action. The how, when, and where of the instruction depends heavily on the Student Model. The Intelligent Interface must make the match of the Student Model to the student, pick the correct format of instructions for the lesson, execute the lesson on the simulator, and evaluate the student's progress.

Knowledge Domain

For practical reasons, the Knowledge Domain element comes first. Specifically, this is identified as the 552 AWACW IQT WD Block I, *Weapons Director Student Study Guide, Volume 1,* of training course E3000BQODX. This guide introduces students to AWACS, the WD Multi-Purpose Console (MPC), and several switch actions, building a declarative knowledge base and a procedural knowledge base. The emphasis is on procedural knowledge base, that is, how to perform certain WD switch actions. A specific list of these switch actions is found in Appendix A, a letter from Capt. Fowler, representative of the 552 AWACW/DOQMW office, which is responsible for the training course development at Tinker for WDs.

Simulator

The next element, the Simulator, is the nearest to completion. These are the C^3 Generic Workstations (C^3GWs) and the supporting AWACS Simulation software in the AESOP facility (Schiflett, Strome, Eddy, and Dalrymple, 1990). The C^3GWs have most of the switch actions taught in Block I at Tinker AFB. The following list includes all the Block I switch actions that have not yet been implemented on the C^3GW:

Restricted Area
RN/DES/NTN SD
Add/Delete Airbase
Area Define/Delete
Corridor IFF SD
Radar/IFF Tracking

These switch actions amount to 28% (6/21) of all the switch actions taught in Block I, IQT WD training. An estimated 280 man hours of programming development are needed to fully develop these switch actions. In all other respects, the Simulator element closely emulates the presentation and functions of an AWACS WD MPC.

Instructor Model

The Instructor Model element contains instructional goals, accounts for student attributes, structures the Knowledge Domain, and presents the structure. The goals center around transfer of knowledge from the Knowledge Domain to the student. Specifically, these goals are to teach the student:

1. The physical layout of the MPC, i.e., where the switch action buttons are located.

2. The procedural steps for executing MPC Console Checkout.

3. The procedural steps for executing the following switch actions:

Assign Console	TD Index
Line	Circle
Coordinate	Tactical Bearing & Range
Restricted Area	Bearing and Range
RN/DES/NTN SD	Initialize Special Point
Add/Delete Airbase	Area Define/Delete
Locate SIF	Corridor IFF SD
Request SIF	Initiate
Mode IV	Reinitiate
Radar/IFF Tracking	Assign/Defer
Request/Assign IFF/SIF	ADS Panel Channel activations

These goals lay the foundation for evaluating the student's performance. Acceptable execution of these procedures by a student WD indicates successful transfer of knowledge. However, defining acceptable execution involves several measures:

- time of complete task execution,
- time of execution of each step within the task,
- a time window for accepting task start and end, error toleration, and alternate step sequencing, when it exists.

The values that address these measures are not currently known with certainty. Therefore, our initial set of values for evaluation were determined by a Subject Matter Expert based on years of experience as a WD/SD/IWD. The set of values chosen for different students is based on student attributes.

Student Model

Accounting for student attributes requires recognizing appropriate student differences, setting appropriate goals based upon these student differences, and then selecting a mode of instruction that best matches both the student and the instructional goals. Recognizing appropriate student differences relies heavily upon the Student Model. A WD student is matched to his/her appropriate type in the Student Model. Once the student type is known, then the Instructor Model has the correct set of instructional goals to tie to that student type. Our prototype has only one set of instructional goals based on the lowest level of student type. Selecting a mode of instruction impacts how the Knowledge Domain is structured and how information is presented.

Necessary WD Knowledge/Skills

There are three distinct, but interrelated areas of knowledge/skill necessary to be a functioning and qualified AWACS WD. These are declarative knowledge, procedural knowledge, (Barr & Feigenbaum,1981; Anderson, 1988) and operational skills.

Declarative knowledge refers to that specialized body of knowledge about the system, its purpose, components, events, and the relationships among them. A few examples are how radar works, the different types of intercept geometry, airpower doctrine, and brevity code words.

Procedural knowledge deals with task procedures needed to operate the equipment. Some examples include reading scope presentations, talking and listening using the communications equipment, and executing switch actions.

Operational skills encompass knowledge at both cognitive and meta levels (Burton, 1988). At the cognitive level, the WD needs to acquire some high level skills to cope with the demands of a complex task environment in order to properly apply the declarative and procedural knowledge in both normal and abnormal problem solving situations (Woods, 1988). Time management and cost-benefit analysis are two skills necessary for the proper coordination of multiple WD tasks in a complex and dynamic environment. Proper coordination is important because system events compete for the operator's attention. Other critical skills resulting from the dynamic, complex nature of the system include adaptiveness and disturbance management that are common to other complex systems. Two that are critical to the WD world include dichotic listening and three dimensional spatial orientation involving motion of objects while remaining stationary.

Meta skills concern knowledge about how to learn effectively. The body of knowledge the novice WD must learn can be overwhelming. Consequently, at the meta level, the WD

needs to know how to monitor the learning process and manage different activities to get the most out of training.

The declarative and procedural knowledge together form the domain knowledge the operator must have. Operational skill can be viewed as the operator's successful acquisition and application of the domain knowledge during training that transfers to the actual task environment.

Skill Levels

In each of the three areas, a WD is rated on a scale of 1-5, with 5 being the highest. Each numerical rating corresponds tc a label ranging from 1-Naive, 2-Novice, 3-Journeyman, 4-Expert, and 5-Master. The following is a description of each label/rating:

1 NAIVE:	Indicates a complete lack of knowledge and/or skill.
2 NOVICE:	Has some knowledge and/or skill, but not enough to operate independently to complete assigned tasks in a timely manner. Does not recognize all patterns of stimuli. Does not know how to order behavioral actions in response to recognized patterns of stimuli.
3 JOURNEYMAN:	Has enough knowledge (score 85% or better in written exams) and/or skill to operate independently to complete assigned tasks, but not always in a timely manner. Recognizes common stimuli variable patterns and applies domain rules of behavioral responses. Does not recognize situations in which the domain rules do not apply, and/or in which new variables or patterns exist. Perseveres in attempting to apply what is known. Not yet capable of solving difficult or complex problems or developing new rules.
4 EXPERT:	Has superior knowledge and/or skill. Operates well independently to complete all assigned tasks in a timely manner. Recognizes common stimuli variable patterns and applies domain rules of behavioral responses. Recognizes existence of new variables and/or situations in which the domain rules no longer apply, and can usually develop a solution. Capable of solving most difficult or complex problems.

5 MASTER: Has superior knowledge and/or skill. Operates well independently to complete all assigned tasks in a timely manner. Recognizes common stimuli variable patterns and applies domain rules of behavioral responses. Recognizes existence of new variables and/or situations in which the domain rules no longer apply, and can develop new rules. Capable of solving difficult or complex problems.

The goal of the training in Block I AWACS WD training is to bring all students up to the NOVICE/level 2 for Procedural Knowledge, Declarative Knowledge, and Operational skill.

Course Structure

Since the Knowledge Domain consists largely of Procedural Knowledge, the required step sequences are already structured. Yet there is a need for a comprehensive course outline that addresses the goals of Procedural Knowledge to be taught in each lesson, how many lessons there will be, and how fast the pace of presentation will be. The course outline is currently taken from Appendix A and Appendix B, the IQT-WD READING GUIDE (6 JUN 90). Note that the maximum time allowed for the course is specified, but no minimum time is established.

Student Skills Assessment

For this proof of concept prototype, we developed a Student Skills Assessment module to categorize student WDs (from 1-Novice to 5-Master) according to experience and ability. This module consists of an Experience Questionnaire and a Switch Action Exercise that students complete on the console prior to the first lesson. A printed copy of this questionnaire is included as Appendix C. Although it is highly probable that the students taking this course are novice WDs just graduated from the introductory course at Tyndall AFB, exceptions occur with sufficient frequency that they must be addressed. For example, occasionally a student may have extensive experience either as a WD or as an aircraft controller and must be requalified as required by regulations. The multiple-choice questionnaire ascertains the same information usually gleaned from the student's records or informally gathered by the instructors during the lesson breaks. In addition, where the student indicates a proficiency above basic entry level, the Switch Action Exercise is presented to validate the evaluation. The normal Lesson One, Block I instruction is then presented.

The first lesson consists of three parts and is presented at only one pace of instruction. The Instructor Model does not evaluate the student during the lesson, only after the lesson is complete. The capability to evaluate the student during the lesson and the capability to change the lesson mode if necessary, need to be more fully developed.

Lesson One

The Simulator Model is the means of instructional presentation and involves five phases of instruction in this high performance Knowledge Domain (Fink, 1990):

(1) Static overview knowledge,

(2) General procedure-oriented knowledge,

(3) Guided example exercises,

(4) Unguided example exercises, and

(5) Automated example exercises.

Static overview knowledge consists of a general description of the salient parts and features of the particular piece of equipment on which the task will be performed. This static overview is not included in the prototype. Instead, it is left to the written material found in the IQT WD Student Study, Vol. I.

General procedure-oriented knowledge consists of a description of the steps that must be performed in executing the procedure being taught. Parts of the equipment involved and the motivation or effect for each step are indicated. Each of the lessons should start here for the lowest level student. The first part of Lesson One describes the steps and indicates where the switches are. It doesn't give any motivations for each step or each step's effect on the overall status of the goal.

Guided example exercises provide the student with the opportunity to practice with specific examples while being prompted and coached in order to develop accuracy in the skill. The second part of Lesson One presents a procedure the student must perform on the Simulator. Instructions guiding the student are presented, but the student is not evaluated during the lesson.

Unguided example exercises provide the student the opportunity to practice the whole process with specific examples without interruption in order to develop speed with accuracy. This is the third and final part of the Lesson One. The student is given ten minutes to execute the Console Checkout while reading and following the Console Checkout checklist. After ten minutes, the lesson is terminated and the data on student performance is gathered and evaluated. In future ITS development, this process should be automated.

Automated-example exercises provide the student the opportunity to practice the entire process with specific examples while doing another task. These types of exercises allow the WD to develop the capability to perform tasks automatically. The first lesson is not designed to use this phase. However, Console Checkout is done at the beginning of each and every lesson. As the lessons proceed, the time for this procedure's completion will narrow down from ten minutes to three minutes.

Developing the Software

The development of this prototype was accomplished with a minimum amount of coding change to the existing AWACS Simulation software. Rather than having the two pieces of software integrated, the ITS software executes as a separate process from the simulation, but uses the data collected in the Logger File as input for evaluation. The intent is to have both pieces of software execute in an alternating fashion so the results of one can be used in the next execution of the other. Hence, the ITS software brackets the simulation to provide the appearance of an imbedded simulation without actually accomplishing the imbedding process. On the front end, the ITS software provides the interaction necessary to instruct and evaluate the student before selecting an appropriate scenario for the AWACS Simulation. Then on the back end, the ITS software evaluates the student's performance during the simulation before presenting the appropriate follow-on instruction area.

Admittedly, using two computers systems to provide the functionality for the AWACS ITS is not the ideal solution. However, it does provide a flexible test platform upon which to develop some quantitative metrics for estimating the skills of the student WD. While pedagogy suggests the development of high-performance skill is best accomplished via consistent practice, establishing the criteria to judge the WD student still requires significant amounts of definition and refinement.

AWACS ITS Program Documentation

The software for the AWACS ITS was developed on both the UNIX based Silicon Graphics (SG) 4D/50 and the DEC VAX 780 computers using *C* and the *Curses* screen handling package. With the exception of the simulation graphics (SG only), all user interaction can be accomplished using either the SG graphics or DEC VT200 series terminals. Source files are included as Appendix D.

The AWACS ITS operates as three separate parts.

1. The SG 4D/50 software provides the instructional capability for the ITS.

2. The Simulation software provides the hands-on aspect of the WD's console operation.

3. The VAX 780 software is the first iterative trial to evaluate a WD's actual console operation.

Since the Simulation software is documented elsewhere, it will not be reiterated and documentation of the remaining two functions follows[1]. An ITS User's Guide is included as Appendix E.

Silicon Graphics Software

As developed, the software exists in 7 source files and have the following functional relationships:

itsdef.h: Header file for the ITS software.

ITS.c: The overall controlling function

its_rutns.c: Common functions shared by the software

instructor.c: Controls the presentation of the test material.

instr_rutns.c: Common functions shared in the instructor function.

student.c: Provides the student interface and student function.

stdt_rutns.c: Common functions shared in the student function.

All source and executable files exist on the SG 4D/50 called *Picard*. In addition, there is an ancillary file, called ITS.mak, that can be used with the UNIX *Make* utility to control the compilation and linking of the modules that are required to form the executable.

Documentation for the calls to the Curses screen management package can be found in the IRIS-4D Programmer's Guide Vol. II and the IRIS Programmer's Reference Manual, Vol. II, Sec. 3, Curses(3X).

[1] Systems Research Laboratories, Inc.: "Research and Development Computer Software Report, Delivery Order 0008, Attachment 2, Sequence 1", Contract No. F33615-87-D-0601, September 1990.

Implementation

In order to provide a means of presenting a flexible curriculum, the instruct.blk file was created. This file exists in the *Instructor* directory and contains a catalog of available instruction blocks (max = 50) and the individual lessons (max = 50) that comprise each instruction block. Each catalog entry (logical record) is a string of 634 characters that consists of 52 fields as follows:

1. Brief description of the instruction block (max = 80 characters).

2. A two digit field containing a count of the lessons in this instruction block.

3-52. 50 10-character fields containing the names of the lesson files.

Additionally, each field is separated by a |. As developed, each catalog entry can thought to be an instructional block comprised of one or more lessons. Wherein, each lesson consist of a series of text and questions.

Since the intent was to create a subject matter independent ITS, the majority of the intelligence has been placed in the formation of the lesson file. Consequently, the lesson file has a "programmable" flavor to its format and usage. Currently, each lesson file can be created by specifying the following types of **text_types** via the use of the "vi editor".

a) Each **text type** is separated by a **Ctrl-L** character. In addition, this character also causes a form feed when the file is printed.

b) The first line of each **text type** has the following format:

numeric_id text_type

where:

numeric_id = a decimal value that uniquely identifies (within a given lesson context) the **text_type**.

text_type = one of the following:

1. text
2. multiple choice
3. true/false
4. yes/no
5. noscore
6. score
7. instruct/lesson

For example, suppose you wanted to specify a multiple choice presentation and 4 other displays already exist in the lesson. Additionally, let the previous presentations be numbered 1, 10, 20, and 30, respectively, then this multiple choice presentation could be specified as:

12 multiple choice

c) The second line of each **text type** has the following format:

numeric_id$_1$ numeric_id$_2$ numeric_id$_3$ numeric_id$_4$ numeric_id$_5$

where:

numeric_id = the numeric_id of a **text type** that is associated with a given "knowledge level" where level 1 corresponds to the lowest and 5 to the highest.

Continuing the previous example, suppose we plan to advance to **text type** identified as **11** for knowledge levels 1 through 3, and **15** for all others. Our example would now appear as:

12 multiple choice
11 11 11 15 15

d) If the **text type** is that of **text**, then the third line contains a count of the number of lines in the presented text that follows it.

Varying our example slightly to account for the **text** specification, the example would appear as:

12 text
11 11 11 15 15
36
This is a test example of the **text** ...

where the ellipsis indicates the continuation of 36 lines of text as specified by the third line of our example.

e) For the remaining **text types**, the third line consists of multiple occurrences of the format:

z)y

For the **score** and **noscore** types, the y_n values are maximums for intervals that are used in the determination of upgrades in knowledge level, i.e.,

$0 < \text{score} \leq y_1$ -> knowledge level 1
$y_1 < \text{score} \leq y_2$ -> knowledge level 2
$y_2 < \text{score} \leq y_3$ -> knowledge level 3
$y_3 < \text{score} \leq y_4$ -> knowledge level 4
$y_4 < \text{score} \leq y_5$ -> knowledge level 5

For example, these options could appear as:

```
12 score
11 11 11 15 15
1)10 2)20 3)30 4)40 5)50
```

or

```
12 noscore
11 11 11 15 15
1)10 2)20 3)30 4)40 5)50
```

Whereupon, if the student's accumulated score were 23, then the next display would be the one that is annotated as 11.

For the **instruct/lesson** type, the z_n is the index of an instruction block and the associated y_n is also an index of the appropriate lesson within the instruction block.

An example of this type may appear as:

```
12 instruct/lesson
1 1 1 10 20
0)0 0)0 0)0 1)0 2)0
```

Whereupon, if the student were estimated to have a knowledge level of 5, then the next instruction block to be presented has an index of 2 within which the lesson having the index of 0 will be used. Furthermore, the display annotated as 20 will be the beginning presentation.

f) For the **text type** of **multiple choice**, **true/false**, and **yes/no**, the fourth line specifies the number of lines in the text that follows it.

g) The **text type** of **score** and **noscore** resulted from attempted use of a lesson. The **noscore** type uses the accumulated score to branch to an appropriate

follow-on text/question. Whereas, **score** updates the knowledge level variable in the student's data base and resets the accumulated score to zero.

Each of the lesson files that are created using the above format must also reside in the Instructor directory along with the file labeled **welcome**. This file is another lesson file and contains the queries for the Experience Questionnaire.

In addition to the Instructor directory and its associated files, a *Student* directory must also exist. This contains a file that is associated with each student that uses the system. The purpose of each student file is to house the critical values from each student's run. However, these critical values have yet to be determined so each student file is for all practical purposes empty.

Each student's file is labeled as **sdb_xxxx**. Wherein, the **xxxx** field consist of the last four digits of the student's SSAN.

Program Documentation

itsdef.h

This is the header file for this portion of the ITS software. It contains the definitions of the variables and structures that are common to a large majority of the modules.

ITS.c

This file contains the basic controlling logic for the appropriate calling the of the Instructor and Student functions. It also presets some of the global variables.

its_rutns.c

This module contains those functions that are, generally, common to all the other modules and functions in this portion the ITS.

Contains the following functions:

void cntr_ln(int y_coord, char *txt_str)
This function will center the text in **txt_str** in the line specified by **y_coord**.

void get_path_str(char *directory, char *path_str)
This function queries the user for the full directory path for **directory** and returns the full path string in **path_str**.

void file_str(char *path, char *filename, char *fullstr)
This function returns the full file string in **fullstr** from **path** and **filename**.

void its_stop()
This function cause the appropriate escape from Curses and terminates the execution of the program.

int chk_file(char *path, char *filename)
This function checks the accessibility of the file specified from the conjunction of **path** and **filename**.

void lesson_blk_io(char io_type, int ndx)
This function provides the read/write function for the **instruct.blk** file. (See section on the **instruct.blk** for full description of this file.) By specifying a **R** or **W** for the read or write function, respectively, this function will read/write the record that is indexed by **ndx**.

void work_msg()
This function presents a blinking "Working..." message while some time consuming operation is being performed.

void getstr_echo(char *str)
This function echoes the contents of the character string **str** as it is being entered.

void strg_blnk_pad(char *strng, int str_len)
This function pads a left justified string, **strng**, with blanks until the specified length, **str_len**, is attained.

instructor.c

As currently implemented, this routine provides the maintenance functions (add, delete, and modify) for the entries in the **instruct.blk** file. Consequently, it is used to govern the flow of presentations for the ITS.

As seen on the main selection menu, provisions do exist for:

a. reviewing a prepared instruction block,
b. reviewing a student's record, and

c. adjusting a student's record, i.e., examining the scores that have the student has accumulated and adjusting these values as required.

Regrettably, none of these options were implemented because of the lack of quantifiable information concerning the criteria that could be used to appraise the skills of a WD student. It is hoped that with continued development these criteria will be further defined. Whereupon or concurrent with this development, the contents of the student record would be established as well as the methods and content of the material to be taught.

instr_rutns.c

These routines support the **instructor.c**.

void lesson_blk_rec_init(int ndx)
This function initializes the record in **instruct.blk** that is specified by **ndx**.

int lesson_list(max_cnt)
This function presents a list of the available instruction blocks, as specified by **max_cnt**, in **instruct.blk** and returns the index of the selected record.

void lesson_blk_chk()
This function is a debug tool that will display a selected record from **instruct.blk**.

void instr_blk_vis(int ent_no)
This function displays a record from **instruct.blk** that is specified by **ent_no**.

void make_pos(int ndx, int *y_pos, int *x_pos)
This function will provide the screen coordinates, **x_pos** and **y_pos**, relative to the **instr_blk_vis** display that corresponds to index **ndx** of the desired lesson.

student.c

This routine uses a lesson file to present the material in a manner that resembles the traversal of a decision tree. The working version of this decision tree is included as Appendix F. The combined use of *knowledge level* and *accumulated score* are the attributes that key the order of presentation to the student.

It should be noted that there exists a software imposed limit of 100 entries (occurrences of **text type**) per lesson file. This limit can be easily changed as required. Also, the software does not preclude the concatenated presentation of multiple lesson files.

Consequently, the 100 entry limit can be circumvented by the subdivision of a large lesson file into smaller files.

stdt_rutns.c

Contains the following functions:

void student_ident(char *name_str, char *id_str)
This routine queries the user for the student's name and SSAN and returns the values in **name_str** and **id_str**, respectively.

void get_ssan(char *a_strng)
This function controls the user's specification of a SSAN and returns the value in **a_strng**.

void student_blk_io(char io_type, int rec_ndx)
This function provides the equivalent I/O capabilities as found in **lesson_blk_io**, but these apply to a student data base.

void read_prsnt_txt(int map, int *file_offset, int *disp_map, int *disp_ndx, char *disp_str)
This routine reads a line of text, pointed to by **file_offset**, from a streamed file into a buffer that is pointed to by **disp_str**. If **map** equals a -1, then the entry that is indexed by **disp_ndx** in the seek address list, **disp_map**, is built. And in all cases, the next value of **file_offset** is computed.

int prsnt_txt(int map_ndx)
This routive presents a text that is pointed to by **map_ndx**, which is an index into another list that contains some positional information about each block of text in a given lesson.

int score_txt(int map_ndx)
This routine uses the lesson map entry, indexed by **map_ndx**, to score the preceding portion of a lesson block. It also asks the user to review any preceding answers before scoring the section.

int lesson_txt(int map_ndx)
This routine uses the lesson map entry, indexed by **map_ndx**, to determine the next instruction/lesson block to be presented based upon the user's knowledge level.

void get_max_min(int map_ndx)

This routine uses the lesson map entry, indexed by **map_ndx**, and determines the highest and lowest values that are in the answer set. The sum of the max and min values are stored in the user's data base.

void reply_pos(int map_ndx)

This routine uses the lesson map entry, indexed by **map_ndx**, to position the cursor in the appropriate screen position for a user's response to either a **multiple choice**, **true/false**, or **yes/no** type of question.

DEC VAX 780

As stated earlier, the interviews with several IWDs were inconclusive in the attempt to establish some quantifiable criteria for measuring the developing skills of a student WD. But these interviews did indicate that a common appraisal basis did exist in a non-verbal context. Consequently, the approach of this development was to provide a first approximation and target for criticism using "timely completion of an action" as a starting criterion in order to elicit critiques from the IWDs. In turn, these comments would be used to improve the criteria, find new metrics, and improve the expert model. Hence, several versions of the software are expected to evolve. So rather than saying that the software "evaluates ...", the term "attempts to evaluate ..." is applied to connote that major revisions to this software are expected with the possibility that our initial criteria could be decomposed, tossed out, or embellished.

As developed, this software exists in 3 files and have the following functional relationships:

sdt_eval.h: This is the header file for the DEC VAX 780 portion of the software.

sdt_eval.c: This is the overall controlling function for this portion of the software. It attempts to evaluate the switch responses of the WD user.

eval_rtns.c: These are the common functions that are used in sdt_eval.c during the evaluation process.

Implementation

In order to evaluate the output from an AWACS scenario in the most flexible manner possible, the software uses a script to evaluate a WD's console operation skills. This script can consist of one or more user-supplied events that are described to the software by the use of keyword values. All these values are taken from either a streamed filed called **switches.dat** or are part of the software.

The keyword values that are taken from **switches.dat** consist of the names, coded values, and code ids of the:

a. Feature and Category Select switches
b. Alarm/Display Control Panel switches
c. Function Select Panel switches

All fields are left-justified and separated with the | character to assist with visual discrimination. The format of each record is as follows.

Field 1 (27 characters): This is the name of the switch as they are identified on a WD's workstation console.

Field 2 (4 characters): A 4-digit field that corresponds to numerical value of the switch as it is encoded in the Simulation software (See file **switches.h**).

Field 3 (3 characters): When available, these characters correspond to an abbreviated value used by the **switches.c** software in its output to the Logger file.

For example the specification of *Bearing & Range* function switch appears as:

BEARING RANGE |23 |B-R

Those keyword values not taken from the **switches.dat** file are coded into the software. These consist of the terms:

a. Checkout Console: Used to demarcate an event consisting of the Console Checkout procedure.

b. Done: Used to indicate the termination of a script.

c. Window: Used to specify a maximum period of time (no. of seconds) during which an event should occur.

d. Key: Used to specify the numerical value that is associated with an event on a logger file.

e. Text: Used to specify a text value that can be used for additional discrimination.

f. Alternate: Used to specify a function switch action. In addition, this option can be specified in groups such that each group represents an another method of performing an equivalent action.

Each user-supplied event is listed in a file and separated from each other by an empty line. In addition, each event is tagged with a field [1-4 characters] that must start with a numeric and is terminated with a :. The follow-on field can be either:

a. A label [1-27 characters]
b. Keyword value **Checkout Console**, **Done**, or those that are found in the **switches.dat** file.

Thus, an event is denoted by a line that has the follow specification:

tag: {label, appropriate keyword}

where one of the fields enclosed between **{...}** is necessary, but interchangeable. Additionally, if a label is used, then the use of the **key**, **text**, and **alternate** options are also required.

For example, suppose we wanted to describe the Console Checkout event follow by some event called "Find and Tag a Tanker." These could appear as:

```
1: Checkout Console
        .
        .   Other options
        .

2: Find & Tag Tanker
        .
        .   Other options
        .
```

The next line that is associated with the specification of an event has the following format.

window = xxx.xx

where the field **xxx.xx** denotes the specification of a floating point value indicating the number of seconds within which the associated event must be completed.

In our example this specification would appear as:

```
1: Checkout Console
   window = 180.0
        .
        .    ]  Other options
        .
```

```
2: Find & Tag Tanker
   window = 60.0
        .
        .    ]  Other options
        .
```

The **key** option line has the following format.

key = xxxx

where the field **xxxx** is an integer value that corresponds to a keyword value that is found in the **keywords.h** file from the Simulation software.

For our example, if each event were tied to a message, then they would appear as:

```
1: Checkout Console
   window = 180.0
   key = 1014
        .
        .    ]  Other options
        .
```

```
2: Find & Tag Tanker
   window = 60.0
   key = 1014
        .
        .    ]  Other options
        .
```

The **text** option line has the following format.

text = '{text string (1-27 characters)}'

where the text string that is enclosed between single quotes consist of the same or all of the leading characters in the free text portion of a logger file record.

Again, in our example this specification would appear as:

```
1: Checkout Console
   window = 180.0
   key = 1014
   text = 'a text string'

2: Find & Tag Tanker
   window = 60.0
   key = 1014
   text = 'another text string'
        .
        .    ] Other options
        .
```

The specified **key** and **text** values are use to find the next occurrence of these values in the logger file and constitutes the start of an event. Whereupon, the use of one or more groups of the **alternate** option takes place.

For the **Checkout Console**, the use of the next option is recognized. However, it is limited to the specification of the **Assign Console** switch action. This feature was added so that the **Assign Console** switch action could be tied to the **Checkout Console** event.

Each **alternate** option line has the following format.

alternate {tag} = {switch action keyword}

where:

tag = 1-8 character field that must start with a numeric.
switch action keyword = the name of a switch that is found in the **switches.dat** file.

A group can consist of one or more repetitions of the **alternate** keyword. For example, suppose an event called "Find & Tag a Tanker" could be identified by the message "01 FIND & T", and could be accomplished using either the **Request SIF SD**, **Locate SIF**, or

Re-Init switch actions. In addition, suppose that this event had to be done in one minute from the time of the message. The event could appear in a script as:

```
1:    Find & Tag a Tanker
      window = 60.0
      key = 1014
      text = '"01 FIND & T"'
      alternate 1 = Request SIF SD
      alternate 2 = Locate SIF
      alternate 3 = Re-Init
```

Now suppose that a fourth method of accomplishing the same event required two switch actions called **Switch 1** and **Switch 2**, then the same event would appear as:

```
1:    Find & Tag a Tanker
      window = 60.0
      key = 1014
      text = '"01 FIND & T"'
      alternate 1 = Request SIF SD
      alternate 2 = Locate SIF
      alternate 3 = Re-Init
      alternate 4 = Switch 1
      alternate 4 = Switch 2
```

It should also be noted that the total number of **alternate** options that can be specified in any single event has a software limit of 25.

Another file of interest is the **logger file**. This is file is a derivative of the original **logger.out** file that is produced during an execution of the Simulation software. This **logger file** is the output of the **Pass 6** operation from the REDUCE software[2] and represents the all the captured data in a time order manner.

Program Documentation

sdt_eval.h

This is the header file for this portion of the ITS software. Like **itsdef.h**, it contains the definitions of the variables and structures that are shared by the programs in the application, i.e., sdt_eval.c and eval_rtns.c.

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[2]Systems Research Laboratories, Inc.: "Research and Development Computer Software Report, Delivery Order 0008, Attachment 2, Sequence 1", Contract No. F33615-87-D-0601, September 1990, pp. 22-26.

Of the structures that are included in this file, the **evnt_skelt** specification and its use as **evnt_desc** requires so some explanation. As **evnt_desc**, this structure contains the controlling information for the analysis of an event. The values are initialized and loaded from the event script file for the each event at the onset of processing. The following is an explanation of this structures usage.

evnt_seq: This is a 4 character array that contains the tag value that is associated with the event.

struct evnt_var evnt_label: This structure contains the information extracted for the event demarcation line, the **Window**, **Key**, and **Text** specification options.

no_var: The contains the number of variations that were specified via the **alternate** options. Suppose that the following event specification were used.

```
1:    Find & Tag a Tanker
      window = 60.0
      key = 1014
      text = '"01 FIND & T"'
      alternate 1 = Request SIF SD
      alternate 2 = Locate SIF
      alternate 3 = Re-Init
      alternate 4 = Switch 1
      alternate 4 = Switch 2
```

The value of no_var would be 4.

step_per_var: This is an array of 5 integer values. Each represents the number of function switch actions that comprise each specified alternate. In the above case, the assigned values would be 1, 1, 1, 2, and 0 for each of the entries in step_per_var.

struct evnt_var variant: This is an array of structures that contains the function switch action information for each of the **alternate** option specifications. Again for the cited example, the first 5 structures would contain the appropriate values.

sdt_eval.c

This program provides the controlling logic for the evaluation of the acquired console operation data.

eval_rtns.c

This is a collection of routines that perform a partial evaluation of the data collected in the logger file.

void cntr_ln(int y_coord, char *txt_str)
This routine is identical to that found in **its_rutns.c**. It centers the text in **txt_str** in the line specified by **y_coord**.

void quick_exit()
This routine calls the **endwin()** function to clean up the Curses software before exiting.

void get_fil_str(char *filename)
This routine prompts the use for an appropriate filename and store the requested string in **filename**.

void open_err(char *filename)
This routine prints a message indicating that an error occurred while opening the file specified in **filename**.

void read_swt_data(FILE *switch_fp, struct switch_ent *swt-ptr)
This routine reads a record from the file pointed to by **switch_fp**, **switches.dat**, loads the values into the entry of the table that is pointed to by **swt_ptr**.

void read_log()
This routine reads a line from the logger file and partially parse the data into the appropriately labeled variables found in the structure of **cur_log_rec**. It also ensures that all fields are null terminated strings.

In addition, this routine also counts excessive pushing of the **message acknowledge** button. (The term "excessive" means pushing the button when no message acknowledgement is required.) Three or more excessive depressions will trigger the start of the computation to determine the tapping variability and the occurrence of the next message will trigger the print of the variability statistic.

void left_just(char *txt_str)
This routine will left-justify the text in **txt_str**.

int swt_label_match(struct switch_ent *swt_tab_ptr,
int swt_cnt, int ent_no)

This routine will search the function switch table, with **swt_cnt** many entries, that is pointed to by **swt_tab_ptr** for a matching value in the evnt_desc structure. If **ent_no** is a -1, then the switch keyword specified in the event demarcation line is used. Otherwise, the name specified in the **alternate** line is used. Moreover, along with the indication that a match has occurred, the associated switch number and abbreviated switch name are also returned.

void blink_msg_on(int line_no, char *txt_str)

This routine will present the text in **txt_str** in a blinking format on the line specified by **line_no**.

void blink_msg_off(int line_no)

This routine clears and turns off the blinking message on line number **line_no**.

void read_event()

This routine reads the event script file and loads the evnt_desc structure that describes the desired event to the software. It is the values in this evnt_desc structure that are used to evaluate an event.

void opt_chk()

This routine is called by read_event to load the evnt_desc structure with the values taken from the **Window**, **Key**, **Text**, and **Alternate** option specifications.

void swt_state()

This routine gets the state (on or off) of the category and feature select switches as they exist prior to the use of the simulation by the WD.

void console_chk()

Currently, this routine attempts to identify the correct execution and completion of steps that affect the category and feature select switches on the Console Checkout checklist. Consequently, this routine's execution is contingent upon the specification of the **Checkout Console** event in a script file.

However, certain empirical assumptions were made as to the action that constitutes the end of the **all switches on** and **all switches off** process. Currently, the completion of the **all switches off** is indicated when the first feature select switch goes to the **on** position and the **all switches on** is indicated when the first function switch action is taken.

In addition, the inclusion of the **alternate** option specifying the **Assign Console** switch action is allowed with the event specification. Hence, taking this switch action is a optional part of the Console Checkout process.

void switch_chk(struct evnt_var *swt_ent)

This routine checks for the selection and **complete** status return of a function switch action, pointed to by **swt_ent**, within a specified time window. This check also exists for a follow-on switch action in which the antecedent switch action remains in effect.

In addition, some very minor checking of some associated switch options were included for only a few of the function switches. This was done as a check of the feasibility of including more expanded option checking.

void csl_chk(int ndx)

This routine is one of the attempts to expand the option checking capability of the application. It tries to examine the **Assign Console** switch action for the WD station indicated by **ndx**.

void cmt_chk()

This routine is an attempt to expand the checking associated with the **Commit** switch action. It tries to identify the pairing, intercept, and mission that were specified.

void win_chk()

This routine is an attempt to expand the **Init** switch action. It tries to determine the object whose symbology was initiated.

void wmc_chk()

This routine is an attempt to expand the **Mode IV** switch action. It tries to determine the object of the mode check.

void multi_switch()

This routine provides the controlling logic to check the **alternate** option specifications that can be associated with an event.

Recommended Development

The following are some suggested software improvements that are directed toward the development of a functional AWACS ITS.

1. Integrate the AWACS Simulation and ITS software into a single package so that it will qualify as an expert system that is limited to switch action procedures. This limitation obviates the knotted problems that are often associated with the inclusion of strategy.

   For the start of this effort, the current ITS operation will be continued, i.e., maintain execution in batch fashion, and improve the software so it can reliably detect the beginning and ending responses to events. In turn, each established detection scheme will be coded into the Simulation software so that the end result should be the limited expert system that is desired.

2. Using the just described, limited expert system as a kernel, this development would add the capability to detect and suggest solutions to switch action procedural problems while the Simulation is running.

   Knowing that the Simulation software controls the scenario presentation to the student and that it can now determine the correctness of switch action procedures, it is now possible to determine the appropriateness of proffered switch action procedures in response to controlled scenario situations. This development would allow the software to passively monitor a student's actions and provide real-time diagnostics as procedural errors occur.

3. Incorporate a reactive Instructor and Student Model into the software that was developed during Step 2.

   Since the software can now monitor a student's switch actions to known situations, this would begin the development of both the Instructor and Student Model software. Essentially, the software will be given the capability to evaluate a student and determine whether the student requires either advancement, remediation, or be kept at status quo. These software decisions will be based upon actions that were taken. Consideration of actions that were omitted will be avoided unless outcomes are blatantly obvious.

The following are suggested changes to the existing software.

1. Besides determining the start and stop of each switch action, each of the of the associated switch-checking modules could be made considerably more intelligent, e.g., devise methods of linking such things as time delays and erroneous inputs with help messages and switch menus. This would, in effect, provide an interim capability for both the student and instructor to review performance.

2. Provide a better prompt for Control key paging functions. This may entail just displaying paging options in appropriate places on the screen, i.e., **Ctrl-P**, **up-arrow**, **Ctrl-B** at the top of the screen and **Ctrl-N**, **down-arrow**, **Ctrl-F** at the bottom of the screen.

3. Options to develop:

   a. Establish a criteria for those values that are to be scored and stored.

   b. Provide a mechanism for the student to review material and answers, but preclude the capability to change original values.

   c. Establish criteria for demotion, promotion, or instructor intervention based upon scores.

4. Build a utility to assist in the development of a lesson and/or instruction block so the instructor's attention can be focused on content and not procedure.

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Systems Research Laboratories, Inc.: "Research and Development Computer Software Report, Delivery Order 0008, Attachment 2, Sequence 1", Contract No. F33615-87-D-0601, September 1990.

Appendix A

3 SEP 91 Ltr from Capt. Fowler

3 Sep 91

Matt,

As promised, here's a breakout of the switch actions taught during Block I of the new IQT WD course, which I believe will enter tryout in late Oct/early Nov. Sorry for the delay; seems something always comes up and obscures little projects like this.

Let me know if I can be of any more assistance. My new number is DSN 884-7232, but Roy Houchin and Tina Livingston are still at the old number (DSN 884-7785).

Regards,
Keith Fowler

Day 1 - Course Orientation; Pubs Posting

Day 2 - Sim Safety; Console Checkout; Assign Console S/A

Day 3 - Assign Console S/A; TD Index S/A; Line S/A; Circle S/A; Coordinate S/A; Tactical Brg/Rng

Day 4 - Same as Day 3, but add ADS Panel familiarization

Day 5 - Restricted Area S/A; Bearing and Range S/A; RN/DES/NTN SD S/A; Initialize Special Point S/A; Add/Delete Airbase S/A

Day 6 - Same as Day 5, but add Area Define/Delete S/A, Locate SIF S/A; Corridor IFF SD S/A

Day 7 - Request SIF S/A; Initiate S/A; Mode IV S/A; Reinit-S/A

Day 8 - Same as Day 7, but add Radar/IFF Tracking S/A; Assign/Defer S/A; Request/Assign IFF/SIF S/A; and study of track blocks.

Day 9 - Building database and situational awareness through use of previously-taught switch actions; using assigned radios; performing flight follow missions

Day 10 - Flight follow; inflight separation; inflight emergencies; and completion of mission related paperwork

Day 11 - Same as Day 10

Day 12 - Practice for unit proficiency check

Day 13 - Block I proficiency check

circles are switch actions we don't have in our Sims

Appendix B

IQT-WD READING GUIDE

IQT-WD READING GUIDE
(AS OF 6 JUN 90)

This guide lists the required daily reading for the IQT-WD course. The daily reading should be accomplished prior to each day training.

Section I lists the reading for Block I (Training Days 1-13). The left column shows the lesson title or switch action and the right column shows the required reading. The documents you'll be reading for Block I are broken down into two volumes (student study guides) and the 28AD HB 55-1, Vol II 20/25.1), also known as the "Positional". The abbreviation (SG) followed by a number tells you which chapter(s) to reference in the study guides. Read the information in the chapter(s) and positional to better prepare yourself for academics and simulator instruction. Many switch actions take up entire chapters. The abbreviation (P) followed by a number tells you on what page the information begins in the "Positional". Some (P) references list specific sections to read. The abbreviation (M) refers to the specific study module that relates to that subject. Again, accomplish all related reading before class.

SECTION I

Day 1	Familiarization & Mechanics	P	1-1 thru 1-12, 1-22 thru 1-28
			1-38 thru 1-40, 3-1 thru 3-14
		SG	1 thru 7, 9 & 10 Assign Cons
		P	3-30 SG 8
	TD Index	P	3-77 SG 15 & 16
	Hard Copy	P	3-41 SG 15
	TD Update	P	3-83 SG 17
	Assign Console	M	MS21:EMER Sim Emergency Proc
Day 2	Line	P	3-49 SG 12
	Circle	P	3-56 SG 12
	Coordinates	P	3-71 SG 13 & 14
	Arrow	P	3-60 SG 11
	Message	P	3-64 SG 11
Day 3	Winds Aloft TD (#44)	P	4-47 SG 17
	Air Base Weather TD	P	3-92, 3-26 & 27, SG 17
	Initialize Special Point	P	3-132 SG 18
	RN/DES/NTN SD	P	3-139 SG 19
Day 4	Identifying Tracks	P	3-15 thru 3-18 SG 22, 24
	Initiate	P	3-148 SG 23
	reinitiate	P	3-151 SG 23
	Mode IV	P	3-300 SG 34
	Drop	P	3-159 SG 23
	Assign/Defer	P	3-239 SG 29 Request SIF P
		3-121	SG 5 (Review), 20
	Locate SIF	P	3-201 SG 29

Day 5	Track Blocks	P	1-28 thru 1-37	SG 25
	Track TDs/Special Point TDS	P	3-164	SG 26
Day 6	Radar/IFF Tracking	P	3-207	SG 29
	Request/Assign IFF/SIF	P	3-268	SG 29
	Area Define/Delete	P	3-125	SG 21
	Corridor IFF SD	P	3-129	SG 21
Day 7	RCT Initialization TD	P	3-184	SG 27
	Add/Delete Air Base	P	3-204	SG 34
	Commit	P	3-212	SG 28, 30
	Cap	P	3-229	SG 28
	RTB	P	3-236	SG 28
	Alter Control	P	3-192	SG 24
Day 8	RCT Mission/Augmented MSN TD	P	3-184	SG 28
	Manual Guidance	P	3-258	SG 29
	Fuel/Configuration	P	3-94	SG 29
	Armament Update/Override	P	3-97	
	Command Tracking	P	3	SG 29
	RCT Mode Control	P	3-256	SG 34
	Aircraft Down	P	3-190	SG 29
Day 9	Mission Modifier	P	3-217	
	Recovery Air Base	P	3-217	SG 28
	Beam Rider	P	3-217	
	Bearing and Range	P	3-43	SG 31
	Tactical Bearing and Range	P	3-4 & 3-89	SG 31
Day 10	Order of Battle Add/Delete	P	3-101	SG 33
	Order of Battle SD	P	3-112	SG 32
	Restricted Area	P	3-306	SG 33
	Present Altitude	P	3-242	SG 34
	Target Altitude	P	3-244	SG 34
Day 11	Intercept Line SD	P	3-143	SG 29
	MA/Kill	P	3-179	
	UHF Tune	P	3-295	SG 34
	WT Handover	P	3-262	
	Accept/Reject Handover	P	3-272	
	Wilco/Cantco	P	3-274	
Day 12	Review All Block I Academics			
Day 13	Written Eval and Critiques			

SECTION II

Section II lists the reading for Block II (Training Days 14-27). The left column gives the lesson titles while the right column shows the required reading. The following abbreviations will be used: (55-3) refers to TAC Regulation 55-3 and associated supplements/attachments, (55-79) refers to Joint Regulation 55-79 and associated documents, (T.O.) refers to Technical Order 1-E-3A-43-1-2, (M) refers to the individual student modules, and (SDC) refers to the Readiness Enhancement Program modules. The SDC readings are optional but do contain valuable information. They are located in the Boeing Learning Resources Center.

Day 14	Mission Flow/WD Responsibilities	M WIL:CC03 Daily Training Missions
	ADS Panel	55-3 Ch 5-2c pgs 5-5 - 5-7
	1v1 Cutoff Geometry	T.O. Pgs 1-166-1-181,5-16& 17
		55-3 Ch 5-3e pg 5-16
		M WIL:CM01 Audio Distribution System
		M ACC:CC0 Crew Coordination
		55-79 Chs 2, 5 & 7 (TAC)
Day 15	Weapons Airspace	M WIL:PE03/PE04 Airspace Types and Usage/FAA Procedures
	Intercept R/T	M ICC: R/T Radio Telephone Transmissions
	MCM 3-1 Brevity Code Words	MCM 3-1 Vol I Attach 1 pgs A1-1-A1-11
Day 16	FAA/Ground Agency Procedures Letters of Agreement (LOA)	
Day 17	E-3 Restart Recovery Procedures	55-3 Sup 1 Ch 6-4D
	Intercept Mission Administration	55-3 Sup 1 Atch I-19 pgs A19-1I A19-21 (WD Log)
	Contending With Variables/Stress	M WIL:CC05 Stress/Contending with Unknown Variables
	Controlled and Uncontrolled Aircraft Emergencies	55-3 Ch 6-4Ce6 pgs 6-25C and 6-16 (Sup 1)
		M WIL:EE01 Controlled Aircraft Emergencies
Day 18	55-79 Training Rules	55-79 Review Chs 2, 5 & 7
	Stern Geometry	55-79 Atch 10 pgs A10-1-A10-2
	Special ROE/55-79 VID Procedures	MCM 3-1 Vol I Review Atch 1
		M Review WIL:CC03
Day 19	E-3 Weapons Guidance/Computer Logic	M ACC:LOG Intercept Logic (Secret, in WPNS safe)

Day 20	Transition Mission		
	ART Briefing	55-3	Ch 5-2f pgs 5-9 and 5-10
		SDC	#19 E-3A Radar System General Description (Secret)
		SDC	#20 E-3A Radar Operations/
	ASO Briefing	55-3	Ch 5-2b pgs 5-4 & 5-5
		SDC	#21 ECM/ECCM Concepts and Procedures (Secret)
		SDC	#22 ECM/ECCM Tactics and Techniques (Secret)
Day 21	Flyups/High Fast Flyer	SDC	#16 E-3 Threat Neutralization & Self Defense Tactics (Secret)
	Tadil-C/Link 4 Mechanics and R/T	55-79	Atch 8 pg A8-1
Day 22	Multiple Cutoff Positioning	M	Review WIL:CCO3
Day 23	Stern Geometry Multiple/ Simultaneous Intercepts	M	Review WIL:CCO3
Day 24	F-15 Liaison Briefing		
Day 25	CDMT Briefing	55-3	Ch 5-2e pgs 5-8 & 5-9
	CSO Briefing	55-3	Ch 5-2d pgs 5-7 & 5-8
		M	WCH:HQ Have Quick
		M	XOM:CSEP Communications Security
Day 26	Review	Review All Academic Material	
Day 27	Written Eval and Critiques		

SECTION III

Section III lists the reading for Block III (Training Days 28-32). (SG refers to the Block III Study Guide.

Day 28	Tanker Rendezvous Overview	55-79	Ch 4, Atch 9
		SG	3.1 Air Refueling Overview
	Receive Turn-ons	SG	3.2 Receiver Turn-on Refueling
	Tanker Turn-ons	SG	3.3 Tanker Turn-on Refueling
Day 29	Rules of Thumb for Tankers	SG	3.4 Non-Standard Refueling Procedures
		55-3	Sup 1 6-2Cd pg 6-6C
		55-3	Sup 1 Atch C-3 pg A3-1C

Day 30	Master Question File (MQF) Local Operating Procedures (LOP)	
Day 31	Review	Review All Academic Material
Day 32	Written Eval and Critiques	

SECTION IV

Section IV lists the reading for Block IV (Training Days 33-44). Abbreviations for the reading will be the same as Section II.

Day 33	NORAD/ADTAC Lane Defense and Threat Assessment	55-79 Ch 3, Review Ch 5, 7, Atch and Atch 10 55-3 Ch 5-1b pg 5-2 55-3 Ch 5-2a pgs 5-3 and 5-4 MCM 3-1 Vol XIV Para 3-3 pgs 3-5 thru 3-8 (Secret) CINCNORAD Oplan 3000-84 pg C10-1 (Secret - in Battle staff Rm 118) Region/Sector Oplan 3000 read sector unique book and sup for one (1) of the regions (Secret - Rm 118) SDC #17 NORAD Identification Procedures (Secret) SDC #37 NORAD Organization SDC #39 Authentication Systems and Materials Handling
Day 34	NORAD Briefing	SDC #38 NORAD/AWACS Interoperability SDC #40 Authentication Usage
Day 35	Authenticators	Review MCM 3-1 Vol I Atch 1 & SDC #40
Day 36	Elements of Broadcast Control Resource Battle Management Strike Controller	55-79 Ch 2, 3, 5, 6 & 7 (TAC) SDC #11 Close Air Support SDC #12 Interdiction SDC #13 Interdiction/Battlefield Air Interdiction (Secret) SDC #32 E-3 Employment in the Tactical Arena (Secret)

Day 37	Tactical Battle Elements	SDC	#23 Intelligence Support to AWACS (Secret)
		SDC	#2 Elements of the TACS
		SDC	#3 Roles of TACS in Tactical Air Operations
		M	PTP:MSN Point-to-Point Missions
Day 38	CF Crew Concepts/Force Controller	SDC	#1 Tactical Air Roles and Missions
Day 39	Navy Briefing	SDC	#26 US Naval Organization
	Navy Interoperability	SDC	#27 US Naval Operations (Confidential)
		Naval	Anti-Air Warfare Interoperability (Secret)
	Breaking the ATO	SDC	#5 Air Tasking Order
Day 40	Mission Planning Documents and Resources	55-3	Ch 3
		55-3	28 AD Sup 1 Ch 6 pgs 6-1A/B thru 6-16C
		M	WDA:INI Initialization
		SDC	#28 Mission Planning - Part
		SDC	#29 Mission Planning - Part
	Mission Planning Considerations	M	WDA:RHO Relief Handover
	Map Preparation	M	WIL:MP04 Performing AWACS Monitor
Day 41	Emergency Equipment and Procedures Walk around(Flight line)	T.O.	Section III pgs 3-1 thru 34
		T.O.	Section I pg 1-203 thru 252B
		M	WIL:MP03 Flight Procedures
		SDC	#30 Aircrew Interfaces Part
		SDC	#31 Aircrew Interfaces Part
Day 42	Pre-Eval Mission Planning	MCM 3-1	
	Block V Aircraft Brief Prep		
	DOV Briefing		
Day 43	Pre-Eval Mission Planning		
	Block V Aircraft Brief Prep		
Day 44	Final DOV Sim Check		

SECTION V

Section V lists the reading for Block V (Training Days 45-47). Abbreviations for the reading will be the same as Section II. (SG) refers to Block V Study Guide.

Day 45	Introduction to ACT/DACT	SG	5.1	Introduction to ACT/DACT
	ACT R/T	SG	5.2	ACT Radio Transmissions
	ACT Formations and Tactics	SG	5.3	ACT Formations and Tactics
	F-15/16 Employment/Characteristics	SG	5.4	Aircraft Characteristics
		MCM 3-1		Volumes IV & V (Secret)
		SDC	#4	Aircraft, Weapons and Tactics (Secret)
	Student Aircraft Briefs	SDC	#34	Allied Fighter Characteristics
		55-79 Ch 2, 3, & 5		
		55-79 TAC Ch 7		
Day 46	F-14/18 Employment/	Naval Anti-Air Warfare Interoperability (Secret)		
	Student Aircraft Briefs Review			
Day 47	Written Eval and Critiques			

NOTE: This Reading Guide is subject to change.
Last update: 6 Jun 90 Capt Mike Challman

... PREVIOUS VERSIONS ARE OBSOLETE

Characteristics

Appendix C

Experience Questionnaire

EXPERIENCE QUESTIONNAIRE

1. Have you ever been Mission Ready (MR) qualified as a 17XX ?

   A. Yes
   B. No

2. Were you MR as a _____?

   A. U.S. or NATO E-3 WD/IWD/SD/ISD
   B. U.S. or NATO E-3 ASO
   C. Other

3. You are here because _____.

   A. You've been DNIF for more than 180 days.
   B. You failed an EVAL and are being retrained.
   C. You've only been NATO qualified.

4. Do you have any other 17XX experience ?

   A. Yes
   B. No

5. Your other 17XX experience includes _____ .

   A. MCE
   B. 407L CRC/CRP WC/WAO
   C. 407L CRC/CRP ASO
   D. NORAD/ICELAND/ALASKA ROCC/SOCC WC/WAO
   E. NORAD/ICELAND/ALASKA ROCC/SOCC ASO
   F. Manual Radar (FACP/TSP-43E)
   G. Other

6. Does your other 17XX experience include a stint as an exchange officer with the US Navy in the E-2C ?

   A. Yes
   B. No

7. Did you graduate from Tyndall's Basic WC Course (E30BP-1741A-004)?

   A. Yes
   B. No

8. Were you _____ ?

A. a Distinguished Graduate
B. in the top 25% of your class
C. average
D. barely passed

9. Did you take the automated course?

A. Yes
B. No

10. Were you prior enlisted?

A. US Air Force
B. US Navy
C. US Army
D. US Marine
E. No

11. Are you a former 16XX ?

A. Yes
B. No

12. While you were prior enlisted in the Air Force, did you have the AFSC _____ ?

A. 11XXX
B. 276XX
C. 30XXX (Air Traffic Controller at a RAPCON)
D. Other

13. While you were prior enlisted in the Army, did you have a previous job as ____ .

A. Helicopter pilot
B. Fire control officer for Patriot or I-HAWK battery
C. Radar Air Traffic Controller
D. Joint Stars operator
E. Other

14. While you were prior enlisted in the Navy, did you have a previous job in _____ .

A. Radar Air Traffic Control
B. Air Intercept Control
C. Other

15. While you were prior enlisted in the Marines, did you have a previous job in _____ ?

A. Radar Air Traffic Control
B. Air Intercept Control
C. Other

16. Are you an exchange/liaison officer from _____ ?

A. the U.S. Army
B. the U.S. Navy
C. the U.S. Marines
D. another nation

17. In the US Army, your previous jobs included _____ .

A. Pilot
B. Joint Stars
C. Air Defense Artillery
D. Radar Air Traffic Control
E. ASOC (Air Support Operations Center)
F. Other

18. In the US Navy, your previous jobs included _____ .

A. Pilot
B. Radar Intercept Officer
C. E-2C Naval Flight Officer
D. Radar Air Traffic Control
E. Air Intercept Control
F. Other

19. In the US Marines, your previous jobs included _____ .

A. Pilot
B. Air Defense Artillery
C. Radar Air Traffic Control
D. F-4 Weapons System Operator (WSO)
E. MACS 5/6/7 Radar Control/Air Intercept Control
F. Other

20. You are a _____ officer.

A. United Kingdom
B. Canadian
C. French
D. German
E. Other

21. You have experience in/as _____ .

A. Pilot/Navigator
B. Weapons System Officer (WSO) in F-4/Tornado IDS
C. Schackelton AEW.2
D. NATO E-3 or UK E-3D AEW.Mk.1 ASO
E. NATO E-3 or UK E-3D AEW.Mk.1 WC/WAO
F. Other Radar Control Air Defense Work
G. Other (work not involving Radar)

22. You have experience in/as _____ .

A. U.S. E-3 ASO
B. NATO E-3 WC/WAO
C. NATO E-3 ASO
D. NORAD ROCC/SOCC
E. Ground Radar Weapons Controller
F. Other

23. You have experience in/as _____ .

A. Pilot/Navigator
B. NATO E-3 WC/WAO
C. NATO E-3 ASO
D. NADGE WC
E. Other

24. You have experience in/as _____ .

A. Pilot/Navigator
B. French E-3F WC/WAO
C. French E-3F ASO
D. Other

25. Are you a Fighter Weapons Instructor Course graduate?

A. Yes
B. No

Appendix D

ITS Source Files

NAME: SWITCHES.DAT

```
/*************************************************************************
   For the following, the numerous switches are presented in numerical
   order, but the use of pagination is done to infer a logical order.
   This logical ordering" is as follows:

     a.   0-79:  Function select switches

     b.   80-87:     Feature & Vector switches          Required Switches
          88-105:    Category Select switches          for WD Console
          142-159:   Category Select switches          Checkout

     c.   106-141:  Optional Category Select switches

     d.   160-184:  Display Panel switches
*************************************************************************
```

UHF TUNE	0	
PDA	1	
ORD BAT ADD/DEL	2	
FLIGHT PLAN	3	
FLT PLN ADD/DEL	4	
FLT PLN ASC/DIS	5	
TRACK TD	6	TRK
TD INDEX	7	TD
INIT SPCL PT	8	ISP
RN/DES/NTN SD	9	
ORDER BAT SD	10	
RADAR IFF TRK	11	
AIRBASE WX TD	12	
ADD DEL AIRBASE	13	
HARD COPY	14	
TD UPDATE	15	
RCT INIT TD	16	RIT
WEAPONS SUMY TD	17	
RESTRICTED AREA	18	
OPNL COND TD	19	
UNUSED 1	20	
UNUSED 2	21	
CIRCLE	22	CIR
BEARING RANGE	23	B-R
COMMAND	24	
AADCP OPTION	25	
ADA ENG STATUS	26	
DATA REQUEST	27	
UNUSED 3	28	
UNUSED 4	29	
LINE	30	LIN
COORDS	31	CRD
WILCO/CANTCO	32	
HANDOVER FREQ	33	
CONTROL UNIT TD	34	

FORCE TELL	35	
SAF PAS CORIDOR	36	
AADCP SD	37	
ARROW	38	ARW
MESSAGE	39	MSG
WT HANDOVER	40	
ACC/REJ HANDOVER	41	
CORIDOR IFF SD	42	
AREA MONITOR	43	
AREA DEF DEL	44	
A/C DOWN	45	DWN
DIALOG TEST	46	
ASSIGN CONSOLE	47	CSL
MODE IV	48	WMC
LOCATE SIF	49	LSF
FUEL/CONFIG	50	
ARM UP/ORIDE	51	
MA KILL	52	
INT L/R LINE SD	53	
TRK ALT ORIDE	54	
REQUEST SIF SD	55	SIF
RCT MSN TD	56	RCT
COMMAND TRACKNG	57	
PRESENT ALT	58	
TARGET ALT	59	
RCT MOD CONTROL	60	
REQ/ASG IFF/SIF	61	RQI
DROP	62	DRP
ALL	63	
MANUAL GDNC	64	
CRUISE ORIDE	65	
COMBAT ORIDE	66	
PROFILE ORIDE	67	
RCVY AIRBASE	68	
ALTER CONTROL	69	
INIT	70	WIN
OFF	71	
COMMIT	72	CMT
MISSION	73	
CAP	74	CAP
RTB	75	RTB
BEAM RIDER	76	
ASSIGN/DEFER	77	ARD
RE-INIT	78	WRN
HOOK	79	

FEATURE SEL B	80
FEATURE SEL A	81
FEATURE SEL D	82
FEATURE SEL C	83
FEATURE SEL F	84
FEATURE SEL E	85
VECTOR SW DOWN	86
VECTOR SW UP	87

BOUNDRIES ADIZ	88
BOUNDRIES ADIZ MOM	89
UNSAFE AREA/ENEMY INSTL	90
UNSAFE AREA/ENEMY INSTL MOM	91
GEOREF LAT LONG	92
GEOREF LAT LONG MOM	93
MAP #1	94
MAP #1 MOM	95
MAP #2	96
MAP #2 MOM	97
MAP #3	98
MAP #3 MOM	99
STOPR/BASES	100
STOPR/BASES MOM	101
WEAPONS AIRBASES	102
WEAPONS AIRBASES MOM	103
SELF-GENERAT GEOGRAPHY	104
SELF-GENERAT GEOGRAPHY MOM	105

IDBO	106
IDBO MOM	107
REQUESTED/FORCED SDS	108
REQUEST/FORCED SDS MOM	109
NET PART PRIMARY E-3A	110
NET PART PRIMARY E-3A MOM	111
SPECIAL POINTS	112
SPECIAL POINTS MOM	113
FRIENDLY	114
FRIENDLY MOM	115
HSTL/UNK/FAKER TRK	116
HSTL/UNK/FAKER TRK MOM	117
CROSSTOLD TRACKS-AIR	118
CROSSTOLD TRACKS-AIR MOM	119
SPECIAL MISSION	120
SPECIAL MISSION MOM	121
INTERCEPTOR	122
INTERCEPTOR MOM	123
CROSSTOLD TRACKS-SURF	124
CROSSTOLD TRACKS-SURF MOM	125
ASSIGNED TRACKS	126
ASSIGNED TRACKS MOM	127
UNASSIGNED TRACKS	128
UNASSIGNED TRACKS MOM	129
TADIL-A/LINK 11 DATA	130
TADIL-A/LINK 11 DATA MOM	131
STROBE HISTORY C	132
STROBE HISTORY C MOM	133
STROBE PRESENT C	134
STROBE PRESENT C MOM	135
JTIDS/ERCS DATA	136
JTIDS/ERCS DATA MOM	137
STROBE HISTORY U	138
STROBE HISTORY U MOM	139
STROBE PRESENT U	140
STROBE PRESENT U MOM	141

RADAR HISTORY C	142
RADAR HISTORY C MOM	143
RADAR HISTORY U	144
RADAR HISTORY U MOM	145
RADAR PRESENT C & U	146
RADAR PRESENT C & U MOM	147
SIF/IFF HISTORY C	148
SIF/IFF HISTORY C MOM	149
SIF/IFF HISTORY U	150
SIF/IFF HISTORY U MOM	151
SIF/IFF PRESENT C & U	152
SIF/IFF PRESENT C & U MOM	153
EXERCISE C&U	154
EXERCISE C&U MOM	155
MARITIME HISTORY C&U	156
MARITIME HISTORY C&U MOM	157
MARITIME PRESENT C&U	158
MARITIME PRESENT C&U MOM	159

DATA INTEN TRK	160	
DATA INTEN SNSR	161	
DSPL MODE SID	162	
DSPL MODE FTAB	163	
TEST MODE STANDALONE	164	
TEST MODE WRAP AROUND	165	
TACT B/R RESET	166	BRR
NOT USED3	167	CLR
NOT USED4	168	TST
ALARM/ALERT CLEAR	169	AAC
MSG ACK	170	ACK
ALERT	171	ALT
ALARM	172	ALM
SCALE EXPANSION 1	173	
SCALE EXPANSION 2	174	
SCALE EXPANSION 4	175	
SCALE EXPANSION 8	176	
SCALE EXPANSION 16	177	
SCALE EXPANSION 32	178	
RETURN TO CENTER	179	RTC
CANCEL OFFSET	180	CAN
OFFSET	181	PAN
SID CURSOR BLINK/STDY	182	BSD
TAB CURSOR BLINK/STDY	183	BTD
TACTICAL B/R	184	

```
NAME:  SDT_EVAL.H

#define MAX_LOG_BUF 200

FILE *pass6_fp;
FILE *event_fp;

int x_mid, y_mid; /* Center coordinates for screen */

int wd_cnt; /* No. of WDs that were tested */
/*************************************************************************
For the following arrays, the values are ordered corresponding to the value
sequence in "wd_console_no".  In addition, "wd_cnt" contains the number of
valid entries in each array.
*************************************************************************/
char wd_console_no[3]; /* Console no. of each WD tested (ASCII) */
char wd_id_no[3]; /* WD id no. (ASCII) for associate console */
int msg_ack_cnt[3]; /* Count of extraneous sequential ACKs */
float msg_prev_tim[3]; /* Time of previous message action */
double msg_elap_tim[3]; /* Sum of elapse time */
double msg_elap_tim2[3]; /* Sum of (elapse time)**2 */

int evl_skl_lvl; /* Skill level for evaluation */

long int prev_pass6_pos;

struct switch_ent
{ /* Function switch entry */
   char func_sw_name[28];
   char func_sw_num[4];
   char func_sw_alt_nm[4];
   char func_sw_state[3];
};/* Function switch entry */

int func_sw_cnt; /* Number of function switches */
struct switch_ent func_sw[80];
#define FUNC_SW_LEN (sizeof(func_sw))

int req_sw_cnt; /* Number of required feature & category switches */
struct switch_ent req_sw[44];
#define REQ_SW_LEN (sizeof(req_sw))

int opt_sw_cnt; /* Number of optional switches */
struct switch_ent opt_sw[36];
#define OPT_SW_LEN (sizeof(opt_sw))

int panel_sw_cnt; /* Number of Alarm/Display panel switches */
struct switch_ent panel_sw[25];
#define PANEL_SW_LEN (sizeof(panel_sw))

struct log_rec
{ /* Partially parsed log record */
   char time_str[13];
   char mod_str[10];
```

```
   char key_str[5];
   char trns_str[MAX_LOG_BUF-28];
};/* Partially parsed log record */


struct evnt_mrk
{ /* Event marker */
   long int evnt_file_offset;
   struct log_rec mrk_evnt;
};/* Event marker */

struct log_rec cur_log_rec;

struct evnt_mrk strt_rec;
long int sim_strt_time;
long int prev_evnt_strt_rec;

struct evnt_var
{ /* Event variation */
   char name_fld[28];
   char nbr_fld[5];
   char alt_nm_fld[4];
   char add_mtch_txt[28];
   float tim_win;
   float strt_tim;
   float end_tim;
};/* Event variation */

struct evnt_var prev_swt;
long prev_rec_pos;

struct evnt_skelt
{ /* Event description */
   char evnt_seq[4];
   struct evnt_var evnt_label;
   int no_var;
   int step_per_var[5];
   struct evnt_var variant[25];
};/* Event description */

struct evnt_skelt evnt_desc;
```

```
NAME:  SDT_EVAL.C

#include <stdio.h>
#include <ctype.h>
#include <string.h>
#include <curses.h>

#include "sdt_eval.h"

/*****************************************************************************
This program is an attempt to evaluate a student WD for proficiency in the
subject matter from Instruction Block 1.
*****************************************************************************/
main()
{
extern int x_mid;
extern int y_mid;
extern FILE *pass6_fp;
extern int wd_cnt;
extern char wd_console_no[];
extern int evl_skl_lvl;
extern int func_sw_cnt;
extern int req_sw_cnt;
extern int opt_sw_cnt;
extern int panel_sw_cnt;
extern struct switch_ent func_sw[];
extern struct switch_ent req_sw[];
extern struct switch_ent opt_sw[];
extern struct switch_ent panel_sw[];
extern FILE *event_fp;
extern struct log_rec cur_log_rec;
extern struct evnt_mrk strt_rec;
extern long int sim_strt_time;
extern struct evnt_skelt evnt_desc;
extern char wd_id_no[];
extern int msg_ack_cnt[];
extern long int prev_pass6_pos;

extern void cntr_ln();
extern void quick_exit();
extern void read_swt_data();
extern void get_fil_str();
extern void open_err();
extern void blink_msg_on();
extern void blink_msg_off();
extern void console_chk();
extern void swt_state();
extern void multi_switch();

struct switch_ent *swt_ptr;
char filename[30];
char txt_str[81];
char reply;
int i;
```

```
int valid, no_events;
FILE *switch_fp;
int tmp_int;
char *tmp_chr_ptr;

/* Initialize curses screen management */
initscr();
x_mid = COLS/2 - 1;
y_mid = LINES/2 - 1;

/* Initialize program variables */
func_sw_cnt = 80; /* Number of function switches */
req_sw_cnt = 44; /* Number of required feature & category switches */
opt_sw_cnt = 36; /* Number of optional feature switches */
panel_sw_cnt = 25; /* Number of alarm/display panel switches */
for (i=0; i<3; i++)
   msg_ack_cnt[i] = 0;
prev_pass6_pos = 0;

/* Get name of data file */
mvaddstr(y_mid-1, 10, "Enter name of data file");
get_fil_str(filename);

/* Verify that data file was generated from REDUCE pass6 */
sprintf(txt_str, "Is file \"%s\"", filename);
cntr_ln(y_mid+1,txt_str);
cntr_ln(y_mid+2, "a \"REDUCE pass6\" output [Y/N]?");
reply = tolower(getch());
if (reply != 'y')
{ /* File requires processing */
   clear();
   cntr_ln(y_mid, "Input data file must be preprocessed by REDUCE");
   cntr_ln(y_mid+1, "and the resultant of at least \"pass6\" processing");
   getch();
   quick_exit();
} /* File requires processing */

/* Open specified file */
pass6_fp = fopen(filename, "r");
if (pass6_fp == NULL)
   open_err(filename);

/* Get number of WDs that were tested */
valid = FALSE;
while (!valid)
{ /* Get number */
   clear();
   cntr_ln(y_mid, "Enter number of WDs that were tested: ");
   reply = getch();
   sscanf(&reply, "%d", &wd_cnt);
   if (wd_cnt<=0 || wd_cnt > 3)
   { /* Invalid count */
      cntr_ln(y_mid+1, "An invalid number of WDs was entered");
      getch();
```

```
   } /* Invalid count */
   else
      valid = TRUE;
} /* Get number */

/* Get WD's console number */
for (i=0; i<wd_cnt; i++)
{ /* Get console numbers */
   clear();
   if (i == 0)
      sprintf(txt_str, "Enter console no. of %1dst WD: ", i+1);
   else if (i == 1)
      sprintf(txt_str, "Enter console no. of %1dnd WD: ", i+1);
   else
      sprintf(txt_str, "Enter console no. of %1drd WD: ", i+1);
   cntr_ln(y_mid, txt_str);
   wd_console_no[i] = getch();
} /* Get console numbers */

/* Get WD id number */
for (i=0; i<wd_cnt; i++)
{ /* Get WD id */
   clear();
   sprintf(txt_str, "Enter WD id no for console %c: ", wd_console_no[i]);
   cntr_ln(y_mid, txt_str);
   wd_id_no[i] = getch();
} /* Get WD id */

/* Get skill level */
clear();
mvinsstr(y_mid-4, x_mid-17, "Select skill level for evaluation:");
mvinsstr(y_mid-2, x_mid-6, "1) Naive");
mvinsstr(y_mid-1, x_mid-6, "2) Novice");
mvinsstr(y_mid, x_mid-6, "3) Journeyman");
mvinsstr(y_mid+1, x_mid-6, "4) Expert");
mvinsstr(y_mid+2, x_mid-6, "5) Master");
mvinsstr(y_mid+4, x_mid-5, "Selection: ");
valid = FALSE;
while (!valid)
{
   reply = tolower(getch());
   if (reply == 'q')
     quick_exit();
   sscanf(&reply, "%d%", &evl_skl_lvl);
   if (evl_skl_lvl < 1 || evl_skl_lvl >= 4)
   { /* Not available */
      cntr_ln(y_mid+5, "Evaluation criteria not available");
      getch();
      move(y_mid+4, x_mid+6);
      clrtobot();
      refresh();
   } /* Not available */
   else
      valid = TRUE;
```

```
)

/* Load Feature and Category switch tables */
switch_fp = fopen("switches.dat", "r");
if (switch_fp == NULL)
   open_err("switches.dat");

/* Loading Function switches */
for (swt_ptr=func_sw; swt_ptr<func_sw+func_sw_cnt; swt_ptr++)
   read_swt_data(switch_fp, swt_ptr);
fgets(txt_str, 80, switch_fp);

/* Loading Feature Select switches (Console Checkout) */
for (swt_ptr=req_sw; swt_ptr<req_sw+8; swt_ptr++)
   read_swt_data(switch_fp, swt_ptr);
fgets(txt_str, 80, switch_fp);

/* Loading top 9 Category Select switches (Console Checkout) */
for (swt_ptr=req_sw+8; swt_ptr<req_sw+26; swt_ptr++)
   read_swt_data(switch_fp, swt_ptr);
fgets(txt_str, 80, switch_fp);

/* Loading middle 18 Category Select switches */
for (swt_ptr=opt_sw; swt_ptr<opt_sw+opt_sw_cnt; swt_ptr++)
   read_swt_data(switch_fp, swt_ptr);
fgets(txt_str, 80, switch_fp);

/* Loading bottom 9 Category Select switches (Console Checkout) */
for (swt_ptr=req_sw+26; swt_ptr<req_sw+req_sw_cnt; swt_ptr++)
   read_swt_data(switch_fp, swt_ptr);
fgets(txt_str, 80, switch_fp);

/* Loading Panel switches */
for (swt_ptr=panel_sw; swt_ptr<panel_sw+panel_sw_cnt; swt_ptr++)
   read_swt_data(switch_fp, swt_ptr);

fclose(switch_fp);

/* Get event script file */
clear();
mvaddstr(y_mid-1, 10, "Enter name of event script file");
get_fil_str(filename);
event_fp = fopen(filename, "r");
if (event_fp == NULL)
   open_err(filename);

clear();
blink_msg_on(y_mid, "Getting initial switch settings");
swt_state();
blink_msg_off(y_mid);

clear();
blink_msg_on(y_mid, "Searching for Sim start");
valid = FALSE;
```

```
while (!valid)
{ /* Find start of simulation */
   strt_rec.evnt_file_offset = ftell(pass6_fp);
   read_log();
   if ((strcmp(cur_log_rec.key_str,"848") != 0) ||
      (strncmp(cur_log_rec.trns_str,"SCN 2",5) != 0))
      continue;
   tmp_chr_ptr = strchr(&cur_log_rec.trns_str[5], 'P');
   if (tmp_chr_ptr == NULL)
     continue;
   tmp_int = -1;
   for (i=tmp_chr_ptr-cur_log_rec.trns_str+1;
         i<strlen(cur_log_rec.trns_str); i++)
   { /* Search for blanks */
      if (cur_log_rec.trns_str[i] != ' ')
      { /* Possible start */
         if (cur_log_rec.trns_str[i] == '1')
         { /* Start found */
            strcpy(strt_rec.mrk_evnt.time_str, cur_log_rec.time_str);
            strcpy(strt_rec.mrk_evnt.key_str, cur_log_rec.key_str);
            strcpy(strt_rec.mrk_evnt.trns_str, cur_log_rec.trns_str);
            tmp_int = 0;
            break;
         } /* Start found */
         break;
      } /* Possible start */
   } /* Search for blanks */
   if (tmp_int == 0)
      valid = TRUE;
} /* Find start of simulation */
sscanf(strt_rec.mrk_evnt.time_str, "%d", &sim_strt_time);
blink_msg_off(y_mid);

no_events = FALSE;
while (!no_events)
{ /* Process Event file */
   read_event();
   if (strncmp(evnt_desc.evnt_label.name_fld, "CONSOLE CHECKOUT",16) == 0)
      console_chk();
   else if (strncmp(evnt_desc.evnt_label.name_fld, "DONE", 4) == 0)
      no_events = TRUE;
   else if (strlen(evnt_desc.evnt_label.alt_nm_fld) != 0)
      switch_chk(&evnt_desc.evnt_label);
   else if (evnt_desc.no_var != 0)
      multi_switch();
   else
   { /* Invalid event */
      clear();
      move(y_mid,10);
      printw("Event: %s lacks sufficient description",
        evnt_desc.evnt_label.name_fld);
      getch();
   } /* Invalid event */
} /* Process Event file */
```

```
/* Terminate curses screen management */
endwin();
```

```
NAME:  EVAL_RTN.C

#include <stdio.h>
#include <ctype.h>
#include <string.h>
#include <curses.h>
#include <math.h>

#include "sdt_eval.h"
```

```
void cntr_ln(int y_coord, char *txt_str)
{ /* Center text on specified line */
extern int x_mid;
extern int y_mid;
int i, x_offset;

x_offset = 0;
for (i=0; i<=strlen(txt_str)-1; i++)
{ /* Search for printable characters */
   if (isprint(*(txt_str+i)))
      x_offset++;
} /* Search for printable characters */
x_offset /= 2;
mvinsstr(y_coord, x_mid-x_offset, txt_str);
return;

} /* Center text on specified line */
```

```
void quick_exit()
{ /* Stop Curses and exit */
endwin();
exit(0);
} /* Stop Curses and exit */
```

```
void get_fil_str(char *filename)
{ /* Get a file string */
extern void cntr_ln();
extern void quick_exit();

*filename = '\0';
while (strlen(filename) == 0)
{ /* Filename */
   mvaddstr(y_mid, 10, "Name: ");
   getstr(filename);
   if (strlen(filename) == 0)
   { /* No name entered */
      cntr_ln(y_mid+1, "ERROR: No name was entered");
      getch();
      move(y_mid, 0);
      clrtobot();
   } /* No name entered */
} /* Filename */
if (strlen(filename) == 1 && tolower((*filename) == 'q'))
   quick_exit();
return;
} /* Get a file string */
```

```
void open_err(char *filename)
{ /* Error opening a file */
extern int y_mid;

extern void cntr_ln();
extern void quick_exit();

clear();
cntr_ln (y_mid-1, "Error occurred while opening");
cntr_ln(y_mid, filename);
getch();
quick_exit();
return;
} /* Error opening a file */
```

```
void read_swt_data(FILE *switch_fp, struct switch_ent *swt_ptr)
{ /* Read a record from "switch.dat" */
char txt_str[80];
char *blnk;
char fill[2];
int ndx;

fgets(txt_str, 80, switch_fp);
strncpy(swt_ptr->func_sw_name, txt_str, 27);
swt_ptr->func_sw_name[27] = '\0';
while (swt_ptr->func_sw_name[strlen(swt_ptr->func_sw_name)-1] ==
' ')
   swt_ptr->func_sw_name[strlen(swt_ptr->func_sw_name)-1] = '\0';
strncpy(swt_ptr->func_sw_num, &txt_str[28], 3);
swt_ptr->func_sw_num[3] = '\0';
while (swt_ptr->func_sw_num[strlen(swt_ptr->func_sw_num)-1] == '
')
   swt_ptr->func_sw_num[strlen(swt_ptr->func_sw_num)-1] = '\0';
if (txt_str[32] == '|')
{ /* Alternate name */
   strncpy(swt_ptr->func_sw_alt_nm, &txt_str[33], 3);
   if (swt_ptr->func_sw_alt_nm[2] == ' ' ||
     !isprint(swt_ptr->func_sw_alt_nm[2]))
      swt_ptr->func_sw_alt_nm[2] = '\0';
   else
      swt_ptr->func_sw_alt_nm[3] = '\0';
} /* Alternate name */
else
   swt_ptr->func_sw_alt_nm[0] = '\0';

return;
} /* Read a record from "switch.dat" */
```

```
void read_log()
{ /* Read a logger entry */
extern FILE *pass6_fp;
extern struct log_rec cur_log_rec;
extern int msg_ack_cnt[];
extern float msg_prev_tim[];
extern double msg_elap_tim[];
extern double msg_elap_tim2[];
extern long int prev_pass6_pos;

extern void left_just();

int i;
unsigned int tmp_long_int;
float tmp_flt;
double tmp_dbl;
char log_str[MAX_LOG_BUF];
char *sep;
char *beg_scan;
long int rec_pos;
char *rd_stat;

rec_pos = ftell(pass6_fp);
rd_stat = fgets(log_str, MAX_LOG_BUF, pass6_fp);
if (rd_stat == NULL)
{ /* End of file or error */
   cur_log_rec.time_str[0] = '\0';
   return;
} /* End of file or error */

/* Partially parse logger record */
beg_scan = log_str;
sep = strchr(beg_scan, '¦');
strncpy(cur_log_rec.time_str, beg_scan, sep-beg_scan);
cur_log_rec.time_str[12] = '\0';
beg_scan = sep + 1;
sep = strchr(beg_scan, '¦');
strncpy(cur_log_rec.mod_str, beg_scan, sep-beg_scan);
cur_log_rec.mod_str[9] = '\0';
while (cur_log_rec.mod_str[strlen(cur_log_rec.mod_str)-1] == ' ')
   cur_log_rec.mod_str[strlen(cur_log_rec.mod_str)-1] = '\0';
beg_scan = sep + 1;
sep = strchr(beg_scan, '¦');
strncpy(cur_log_rec.key_str, beg_scan, sep-beg_scan);
cur_log_rec.key_str[4] = '\0';
left_just(cur_log_rec.key_str);
beg_scan = sep + 1;
strcpy(cur_log_rec.trns_str, beg_scan);
cur_log_rec.trns_str[strlen(cur_log_rec.trns_str)-1] = '\0';

if (rec_pos < prev_pass6_pos)
   return;
prev_pass6_pos = rec_pos;
```

```
/* Evaluate Message ACK tapping */
if (strcmp(cur_log_rec.key_str, "1014") == 0)
{ /* Message Presented */
   for (i=0; i<3; i++)
   { /* Find WD console */
      if (cur_log_rec.mod_str[8] != wd_console_no[i])
         continue;
      if (abs(msg_ack_cnt[i]) > 2)
      { /* Compute variability */
         tmp_dbl = (abs(msg_ack_cnt[i])*msg_elap_tim2[i]) -
msg_elap_tim[i];
         tmp_dbl /= abs(msg_ack_cnt[i])*(abs(msg_ack_cnt[i])-1);
         tmp_dbl = sqrt(tmp_dbl);
         tmp_flt = msg_elap_tim[i]/abs(msg_ack_cnt[i]);
         clear();
         move(y_mid, 10);
         printw("ACK tapping: Avg: %f Var: %f", tmp_flt,
tmp_dbl);
         getch();
      } /* Compute variability */
      msg_ack_cnt[i] = 0;
      msg_ack_cnt[i]++;
      msg_elap_tim[i] = 0.0;
      msg_elap_tim2[i] = 0.0;
   } /* Find WD console */
} /* Message Presented */
if (strcmp(cur_log_rec.key_str, "170") == 0)
{ /* Message Acknowledged */
   for (i=0; i<3; i++)
   { /* Find WD console */
      if (cur_log_rec.mod_str[7] != wd_console_no[i])
         continue;
      msg_ack_cnt[i]--;
      tmp_long_int = atol(cur_log_rec.time_str);
      if (msg_ack_cnt == 0)
         msg_prev_tim[i] = tmp_long_int/30000.0;
      else
      { /* Multiple ACK */
         tmp_flt = tmp_long_int/30000.0;
         msg_elap_tim[i] += (tmp_flt - msg_prev_tim[i]);
         msg_elap_tim2[i] += pow((tmp_flt - msg_prev_tim[i]),
2.0);
         msg_prev_tim[i] = tmp_flt;
      } /* Multiple ACk */
   } /* Find WD console */
} /* Message Acknowledged */
return;
} /* Read a logger entry */
```

```
void left_just(char *txt_str)
{ /* Left justify string */
int blnk_sp;
int i;

blnk_sp = TRUE;
while (blnk_sp)
{ /* Left justify */
  if (isspace(txt_str[0]))
  { /* Space found */
     for (i=0; i<strlen(txt_str); i++)
        txt_str[i] = txt_str[i+1];
  } /* Space found */
  else
    blnk_sp = FALSE;
} /* Left justify */
return;
} /* Left justify string */
```

```
int swt_label_match(struct switch_ent *swt_tab_ptr, int swt_cnt,
int ent_no)
{ /* Search for matching switch name */
extern struct evnt_skelt evnt_desc;

struct switch_ent *swt_ptr;
int match;

match = FALSE;
for (swt_ptr=swt_tab_ptr; swt_ptr<swt_tab_ptr+swt_cnt; swt_ptr++)
{ /* Search for matching Function switch */
   if (ent_no == -1)
   { /* Check main event header */
      if (strcmp(swt_ptr->func_sw_name,
evnt_desc.evnt_label.name_fld) != 0)
         continue;
   } /* Check main event header */
   else
   { /* Alternate switch event */
      if (strcmp(swt_ptr->func_sw_name,
        evnt_desc.variant[ent_no].name_fld) != 0)
         continue;
   } /* Alternate switch event */
   match = TRUE;
   if (ent_no == -1)
   { /* Main event */
      strcpy(evnt_desc.evnt_label.nbr_fld, swt_ptr->func_sw_num);
      strcpy(evnt_desc.evnt_label.alt_nm_fld,
swt_ptr->func_sw_alt_nm);
   } /* Main event */
   else
   { /* Alternate switch */
      strcpy(evnt_desc.variant[ent_no].nbr_fld,
swt_ptr->func_sw_num);
      strcpy(evnt_desc.variant[ent_no].alt_nm_fld,
swt_ptr->func_sw_alt_nm);
   } /* Alternate switch */
   break;
} /* Search for matching Function switch */
return match;
} /* Search for matching switch name */
```

```
void blink_msg_on(int line_no, char *txt_str)
{ /* Blink message - ON */
extern void cntr_ln();

setattr(_BLINK);
cntr_ln(line_no, txt_str);
clrattr(_BLINK);
refresh();
return;
} /* Blink message _ ON */
```

```
void blink_msg_off(int line_no)
{ /* Blink message - OFF */
move(line_no, 0);
clrtoeol();
refresh();
return;
} /* Blink message _ OFF */
```

```
void read_event()
{ /* Read event file */
extern FILE *event_fp;

extern void left_just();
extern int swt_label_match();
extern void opt_chk();

char evnt_rec[81];
int i;
char *colon_ptr;
int ndx;
int match;
struct switch_ent *swt_ptr;

fgets(evnt_rec, 80, event_fp);
for (i=0; i<strlen(evnt_rec); i++)
   evnt_rec[i] = toupper(evnt_rec[i]);   /* Change to UPPER case
*/
ndx = strlen(evnt_rec) - 1;
if (iscntrl(evnt_rec[ndx]))
   evnt_rec[ndx] = '\0';   /* Eliminate appended control
character */
left_just(evnt_rec);
if (isdigit(evnt_rec[0]))
{ /* Event found */
   /* Initilize event description */
   evnt_desc.evnt_seq[0] = '\0';
   evnt_desc.evnt_label.name_fld[0] = '\0';
   evnt_desc.evnt_label.nbr_fld[0] = '\0';
   evnt_desc.evnt_label.alt_nm_fld[0] = '\0';
   evnt_desc.evnt_label.tim_win = 0.0;
   evnt_desc.evnt_label.strt_tim = 0.0;
   evnt_desc.evnt_label.end_tim = 0.0;
   evnt_desc.no_var = 0;
   for (i=0; i<5; i++)
      evnt_desc.step_per_var[i] = 0;

   colon_ptr = strchr(evnt_rec, ':');
   ndx = colon_ptr - evnt_rec;
   strncpy(evnt_desc.evnt_seq, evnt_rec, ndx);
   evnt_desc.evnt_seq[ndx] = '\0';
   strcpy(evnt_desc.evnt_label.name_fld, &evnt_rec[ndx+1]);
   left_just(evnt_desc.evnt_label.name_fld);
   match = FALSE;
   match = swt_label_match(func_sw, func_sw_cnt, -1);
   if (!match)
      match = swt_label_match(req_sw, req_sw_cnt, -1);
   if (!match)
      match = swt_label_match(opt_sw, opt_sw_cnt, -1);
   if (!match)
      match = swt_label_match(panel_sw, panel_sw_cnt, -1);
```

```
   if (match)   /* Check if single switch */
      opt_chk();

   if (!match)
   { /* Action Label (Mulitple switch sequence) */
      if (strncmp(evnt_desc.evnt_label.name_fld, "DONE", 4) == 0)
         return;
      opt_chk();
   } /* Action Label (Multiple switch sequence) */
} /* Event found */
return;
} /* Read event file */
```

```
void opt_chk()
{ /* Parse for event options */
extern FILE *event_fp;
extern struct evnt_skelt evnt_desc;

extern void left_just();
extern int swt_label_match();
extern void cntr_ln();

char evnt_rec[81];
int input_options;
char *chr_ptr;
int ndx, ndx1;
int i;
char cur_alt_label[9];
char alt_label[9];
int match;
char err_str[81];
char tmp_str[80];
int tmp_int;

input_options = TRUE;
alt_label[0] = '\0';
while (input_options)
{ /* Process event record */
   fgets(evnt_rec, 80, event_fp);
   if (strlen(evnt_rec) == 0 || (strlen(evnt_rec) == 1 &&
evnt_rec[0] == '\n'))
   { /* No more options */
      input_options = FALSE;
      continue;
   } /* No more options */
   left_just(evnt_rec);
   for (i=0; i<strlen(evnt_rec); i++)
      evnt_rec[i] = toupper(evnt_rec[i]);
   evnt_rec[strlen(evnt_rec)-1] = '\0';
   while (evnt_rec[strlen(evnt_rec)-1] == ' ')
      evnt_rec[strlen(evnt_rec)-1] = '\0';

   if (strncmp(evnt_rec, "ALTERNATE", 9) == 0)
   { /* Alternate switch sequence */
      for (i=9; i<strlen(evnt_rec); i++)
      { /* Search for label */
         if (isdigit(evnt_rec[i]))
         { /* Label found */
            chr_ptr = strchr(&evnt_rec[i], ' ');
            ndx = chr_ptr - &evnt_rec[i];
            strncpy(alt_label, &evnt_rec[i], ndx);
            alt_label[ndx] = '\0';
         } /* Label found */
      } /* Search for label */
      if (strcmp(cur_alt_label, alt_label) != 0)
      { /* Another variation */
```

```
            strcpy(cur_alt_label, alt_label);
            evnt_desc.no_var++;
         } /* Another variation */
         chr_ptr = strchr(evnt_rec, '=');
         ndx = chr_ptr - evnt_rec + 1;
         ndx1 = 0;
         for (i=0; i<evnt_desc.no_var; i++)
            ndx1 += evnt_desc.step_per_var[i];
         evnt_desc.step_per_var[evnt_desc.no_var-1]++;
         strcpy(evnt_desc.variant[ndx1].name_fld, &evnt_rec[ndx]);
         left_just(evnt_desc.variant[ndx1].name_fld);
         match = FALSE;
         match = swt_label_match(func_sw, func_sw_cnt, ndx1);
         if (!match)
            match = swt_label_match(req_sw, req_sw_cnt, ndx1);
         if (!match)
            match = swt_label_match(opt_sw, opt_sw_cnt, ndx1);
         if (!match)
            match = swt_label_match(panel_sw, panel_sw_cnt, ndx1);
         if (!match)
         { /* Invalid switch */
            sprintf(err_str, "\"%s\" is either misspelled or does
not exist",
               evnt_desc.variant[ndx1].name_fld);
            clear();
            cntr_ln(y_mid, err_str);
            getch();
            return;
         } /* Invalid switch */
         continue;
      } /* Alternate switch sequence */

      if (strncmp(evnt_rec, "WINDOW", 6) == 0)
      { /* Window option specified */
         chr_ptr = strchr(evnt_rec, '=');
         ndx = chr_ptr - evnt_rec + 1;
         for (i=ndx; i<strlen(evnt_rec); i++)
         { /* Search for first numeric */
            if (isdigit(evnt_rec[i]))
            { /* Digit found */
               ndx = i;
               break;
            } /* Digit found */
         } /* Search for first numeric */
         if (evnt_desc.no_var == 0)
            sscanf(&evnt_rec[ndx], "%f",
&evnt_desc.evnt_label.tim_win);
         else
            sscanf(&evnt_rec[ndx], "%f",
               &evnt_desc.variant[evnt_desc.no_var-1].tim_win);
         continue;
      } /* Window option specified */

      if (strncmp(evnt_rec, "KEY", 3) == 0)
```

```
   { /* Keyword - numeric form */
      chr_ptr = strchr(evnt_rec, '=');
      ndx = chr_ptr - evnt_rec + 1;
      strcpy(tmp_str, &evnt_rec[ndx]);
      left_just(tmp_str);
      if (evnt_desc.no_var == 0)
         strcpy(evnt_desc.evnt_label.nbr_fld, tmp_str);
      else
         strcpy(evnt_desc.variant[evnt_desc.no_var-1].nbr_fld,
tmp_str);
      continue;
   } /* Keyword - numeric form */

   if (strncmp(evnt_rec, "TEXT", 4) == 0)
   { /* Matching Text */
      chr_ptr = strchr(evnt_rec, '\'');
      ndx = chr_ptr - evnt_rec + 1;
      chr_ptr = strchr(&evnt_rec[ndx], '\'');
      ndx1 = chr_ptr - &evnt_rec[ndx];
      if (evnt_desc.no_var == 0)
         strncpy(evnt_desc.evnt_label.add_mtch_txt,
&evnt_rec[ndx], ndx1);
      else

strncpy(evnt_desc.variant[evnt_desc.no_var-1].add_mtch_txt,
            &evnt_rec[ndx], ndx1);
      continue;
   } /* Matching Text */
} /* Process event record */
return;
} /* Parse for event options */
```

```
void swt_state()
{ /* Get state of switches */
extern FILE *pass6_fp;
extern int wd_cnt;
extern char wd_console_no[];
extern struct log_rec cur_log_rec;

extern void read_log();

int i, j;
char mod_name[10];
long unsigned int swt_bit_map[2];
long unsigned int bit_pic;
int found;

strcpy(mod_name, "Display_x");
for (i=0; i<wd_cnt; i++)
{ /* Get switch state for each WD console */
   mod_name[8] = wd_console_no[i];
   fseek(pass6_fp, 0, SEEK_SET);
   found = FALSE;
   while (!found)
   { /* Search for switch state */
      read_log();
      if (strlen(cur_log_rec.time_str) == 0)
      { /* End of file or error */
         clear();
         cntr_ln(y_mid, "EOF/error reading Logger: swt_state");
         getch();
         return;
      } /* End of file or error */
      if (strcmp(mod_name, cur_log_rec.mod_str) != 0 ||
        strcmp(cur_log_rec.key_str, "7") != 0)
         continue;
      found = TRUE;
   } /* Search for switch state */
   sscanf(&cur_log_rec.trns_str[2], "%8x %8x",
     &swt_bit_map[0], &swt_bit_map[1]);

   bit_pic = 1;
   for (j=0; j<9; j++)
   { /* Top 9 Category switches */
      if (((bit_pic<<j) & swt_bit_map[1]) != 0)
         req_sw[(j+4)*2].func_sw_state[i] = 1;
      else
         req_sw[(j+4)*2].func_sw_state[i] = 0;
   } /* Top 9 Category switches */

   for (j=9; j<27; j++)
   { /* Optional Category switches */
      if (((bit_pic<<j) & swt_bit_map[1]) != 0)
         opt_sw[(j-9)*2].func_sw_state[i] = 1;
      else
```

```
            opt_sw[(j-9)*2].func_sw_state[i] = 0;
        } /* Optional Category switches */

        /* Bottom 9 Category switches */
        for (j=27; j<32; j++)
        {
            if (((bit_pic<<j) & swt_bit_map[1]) != 0)
                req_sw[(j-14)*2].func_sw_state[i] = 1;
            else
                req_sw[(j-14)*2].func_sw_state[i] = 0;
        }
        for (j=0; j<4; j++)
        {
            if (((bit_pic<<j) & swt_bit_map[0]) != 0)
                req_sw[(j+18)*2].func_sw_state[i] = 1;
            else
                req_sw[(j+18)*2].func_sw_state[i] = 0;
        }
        for (j=4; j<12; j++)
        {
            if (((bit_pic<<j) & swt_bit_map[0]) != 0)
                req_sw[j-4].func_sw_state[i] = 1;
            else
                req_sw[j-4].func_sw_state[i] = 0;
        }
    } /* Get switch state for each WD console */
    fseek(pass6_fp, 0, SEEK_SET);
    return;
    } /* Get state of switches */
```

```
void console_chk()
{ /* Evaluate CONSOLE CHECKOUT */
extern int wd_cnt;
extern char wd_console_no[];
extern int req_sw_cnt;
extern struct switch_ent req_sw[];
extern int opt_sw_cnt;
extern struct switch_ent opt_sw[];
extern struct evnt_skelt evnt_desc;
extern struct log_rec cur_log_rec;

extern void read_log();
extern void cntr_ln();
extern void switch_chk();
extern void csl_chk();
extern void quick_exit();

struct evnt_mrk beg_con;
int valid, chk_on_off;
int i,j;
int tmp_int;
char mod_name[10];
int key_code, on_off_state;
float elap_tim;
unsigned int tmp_long_int;
float tmp_flt;
char tmp_str[80];

/* Find starting event */
valid = FALSE;
while (!valid)
{ /* Search for starting event */
   beg_con.evnt_file_offset = ftell(pass6_fp);
   read_log();
   if (strlen(cur_log_rec.time_str) == 0)
   { /* End of file or error */
      clear();
      cntr_ln(y_mid, "EOF/error in Logger: console_chk (1)");
      getch();
      quick_exit();
   } /* End of file or error */
   if (strcmp(cur_log_rec.key_str, evnt_desc.evnt_label.nbr_fld)
!= 0)
      continue;
   if (strncmp(cur_log_rec.trns_str,
evnt_desc.evnt_label.add_mtch_txt,
    strlen(evnt_desc.evnt_label.add_mtch_txt)) != 0)
      continue;
   valid = TRUE;
   strcpy(beg_con.mrk_evnt.time_str, cur_log_rec.time_str);
   tmp_long_int = atol(cur_log_rec.time_str);
   evnt_desc.evnt_label.strt_tim = tmp_long_int/30000.0;
   strcpy(beg_con.mrk_evnt.key_str, cur_log_rec.key_str);
```

```
   strcpy(beg_con.mrk_evnt.trns_str, cur_log_rec.trns_str);
} /* Search for starting event */

for (i=0; i<wd_cnt; i++)
{ /* Cycle all WDs */
   fseek(pass6_fp, beg_con.evnt_file_offset, SEEK_SET);
   tmp_int = 0;
   for (j=0; j<req_sw_cnt; j++)
      tmp_int += req_sw[j].func_sw_state[i];
   for (j=0; j<opt_sw_cnt; j++)
      tmp_int += opt_sw[j].func_sw_state[i];
   strcpy(mod_name, "Switch_x");
   mod_name[7] = wd_console_no[i];
   if (tmp_int != 0)
   { /* All switches must be turned off */
      chk_on_off = FALSE;
      while (!chk_on_off)
      { /* Check for switch turn off */
         read_log();
         if (strlen(cur_log_rec.time_str) == 0)
         { /* End of file or error */
            clear();
            cntr_ln(y_mid, "EOF/error in Logger: console_chk
(2)");
            getch();
            fseek(pass6_fp, beg_con.evnt_file_offset, SEEK_SET);
            return;
         } /* End of file or error */
         if (strcmp(mod_name, cur_log_rec.mod_str) != 0 ||
           strcmp(cur_log_rec.key_str, "101") != 0)
            continue;
         sscanf(cur_log_rec.trns_str, "%d %d", &key_code,
&on_off_state);
         if (key_code < 80 || key_code > 159)
            continue;
         if (key_code > 87 && (fmod((double)key_code, 2.0) !=
0.0))
            continue;   /* Momentary switch */

         if (on_off_state == 1)
         { /* Check if all switches are off */
            if (key_code == 87)
            { /* Vector */
               req_sw[6].func_sw_state[i] = 0;
               req_sw[7].func_sw_state[i] = 1;
               continue;
            } /* Vector */
            if (key_code < 80 || key_code >87)
               continue; /* Ignore all other switches */
            tmp_int = 0;
            for (j=0; j<req_sw_cnt; j++)
               tmp_int += req_sw[j].func_sw_state[i];
            for (j=0; j<opt_sw_cnt; j++)
               tmp_int += opt_sw[j].func_sw_state[i];
```

```
            if (tmp_int != 0)
            { /* Error - All switches not off */
               clear();
               cntr_ln(y_mid+1, "Error: Not all category and
feature switches");
               cntr_ln(y_mid+2, "have been turned off");
               for (j=0; j<req_sw_cnt; j++)
               { /* Search for switch */
                  if (req_sw[j].func_sw_state[i] == 1)
                  { /* Found a switch */
                     move(y_mid+3,0);
                     clrtoeol();
                     sprintf(tmp_str, "%s is ON",
req_sw[j].func_sw_name);
                     cntr_ln(y_mid+3, tmp_str);
                     getch();
                  } /* Found a switch */
               } /* Search for switch */
               for (j=0; j<opt_sw_cnt; j++)
               { /* Search for switch */
                  if (opt_sw[j].func_sw_state[i] == 1)
                  { /* Found a switch */
                     move(y_mid+3,0);
                     clrtoeol();
                     sprintf(tmp_str, "%s is ON",
opt_sw[j].func_sw_name);
                     cntr_ln(y_mid+3, tmp_str);
                     getch();
                  } /* Found a switch */
               } /* Search for switch */
               move(y_mid,0);
               clrtobot();
               refresh();
            } /* Error - All switches not off */
            chk_on_off = TRUE;
            continue;
         } /* Check if all switches are off */

         if (key_code >= 80 && key_code <= 87)
         { /* Feature & Vector - off */
            if (key_code == 80 || key_code == 81)
            { /* A/B - off */
               req_sw[0].func_sw_state[i] = 0;
               req_sw[1].func_sw_state[i] = 0;
            } /* A/B - off */
            else if (key_code == 82 || key_code == 83)
            { /* C/D - off */
               req_sw[2].func_sw_state[i] = 0;
               req_sw[3].func_sw_state[i] = 0;
            } /* C/D - off */
            else if (key_code == 84 || key_code == 85)
            { /* E/F - off */
               req_sw[4].func_sw_state[i] = 0;
               req_sw[5].func_sw_state[i] = 0;
```

```
            } /* E/F - off */
            else
            { /* Vector */
               req_sw[6].func_sw_state[i] = 0;
               req_sw[7].func_sw_state[i] = 0;
            } /* Vector */
         } /* Feature & Vector - off */

         else if (key_code >= 106 && key_code <= 141)
         { /* Turning off optional category switch */
            for (j=0; j<opt_sw_cnt; j++)
            { /* Find switch and reset state */
               if (strncmp(opt_sw[j].func_sw_num,
cur_log_rec.trns_str, 3) != 0)
                  continue;
               opt_sw[j].func_sw_state[i] = 0;
               break;
            } /* Find switch and reset state */
         } /* Turning off optional category switch */

         else
         { /* Turning off other require switch */
            for (j=0; j<req_sw_cnt; j++)
            { /* Find switch and reset state */
               tmp_int = 2;
               if (key_code > 99)
                  tmp_int = 3;
               if (strncmp(req_sw[j].func_sw_num,
cur_log_rec.trns_str,
                  tmp_int) != 0)
                  continue;
               req_sw[j].func_sw_state[i] = 0;
               break;
            } /* Find switch and reset state */
         } /* Turning off other require switch */
      } /* Check for switch turn off */
   } /* All switches must be turned off */

   chk_on_off = FALSE;
   fseek(pass6_fp, beg_con.evnt_file_offset, SEEK_SET);
   while(!chk_on_off)
   { /* Required switches must be on */
      read_log();
      if (strlen(cur_log_rec.time_str) == 0)
      { /* End of file or error */
         clear();
         cntr_ln(y_mid, "EOF/error in Logger: console_chk (3)");
         getch();
         fseek(pass6_fp, beg_con.evnt_file_offset, SEEK_SET);
         return;
      } /* End of file or error */
      if (strcmp(mod_name, cur_log_rec.mod_str) != 0 ||
        strcmp(cur_log_rec.key_str, "101") != 0)
         continue;
```

```
      sscanf(cur_log_rec.trns_str, "%d %d", &key_code,
&on_off_state);
      if (on_off_state == 0)
         continue;
      if (key_code > 159)
         continue;
      if ((key_code > 87 && key_code < 160) &&
        (fmod((double)key_code, 2.0) != 0.0))
         continue;   /* Momentary switch */

      if (key_code <80)
      { /* Assume checkout complete */
         tmp_int = 0;
         for (j=1; j<8; j+=2)
            tmp_int += req_sw[j].func_sw_state[i];
         if (tmp_int < 4)
            continue;
         for (j=8; j<req_sw_cnt; j+=2)
            tmp_int += req_sw[j].func_sw_state[i];
         if (tmp_int < 22)
         { /* Error - Required switches not set */
            clear();
            cntr_ln(y_mid+1, "Error: Required switches not set");
            for (j=1; j<8; j+=2)
            { /* Feature & Vector */
               if (req_sw[j].func_sw_state[i] == 0)
               { /* Not set */
                  move(y_mid+2,0);
                  clrtoeol();
                  sprintf(tmp_str, "%s is OFF",
req_sw[j].func_sw_name);
                  cntr_ln(y_mid+2, tmp_str);
                  getch();
               } /* Not set */
            } /* Feature & Vector */
            for (j=8; j<req_sw_cnt; j+=2)
            { /* Category switches */
              if (req_sw[j].func_sw_state[i] == 0)
              { /* Not set */
                  move(y_mid+2,0);
                  clrtoeol();
                  sprintf(tmp_str, "%s is OFF",
req_sw[j].func_sw_name);
                  cntr_ln(y_mid+2, tmp_str);
                  getch();
              } /* Not set */
            } /* Category switches */
            move(y_mid,0);
            clrtobot();
            refresh();
         } /* Error - Required switches not set */
         tmp_long_int = atol(cur_log_rec.time_str);
         evnt_desc.evnt_label.end_tim = tmp_long_int/30000.0;
         fseek(pass6_fp, beg_con.evnt_file_offset, SEEK_SET);
```

```
            chk_on_off = TRUE;
            continue;
         } /* Assume checkout complete */

         if (key_code == 86)
         { /* Vector */
            req_sw[6].func_sw_state[i] = 1;
            req_sw[7].func_sw_state[i] = 0;
         } /* Vector */
         else if (key_code >= 106 && key_code <= 141)
         { /* Turning on optional switch */
            for (j=0; j<opt_sw_cnt; j++)
            { /* Find and reset state */
               if (strncmp(opt_sw[j].func_sw_num,
cur_log_rec.trns_str, 3) != 0)
                  continue;
               opt_sw[j].func_sw_state[i] = 1;
               break;
            } /* Find and reset state */
         } /* Turning on optional switch */
         else
         { /* Turning on required switch */
            for (j=0; j<req_sw_cnt; j++)
            { /* Find and reset state */
               tmp_int = 2;
               if (key_code > 99)
                  tmp_int = 3;
               if (strncmp(req_sw[j].func_sw_num,
cur_log_rec.trns_str,
                  tmp_int) != 0)
                  continue;
               req_sw[j].func_sw_state[i] = 1;
               break;
            } /* Find and reset state */
            tmp_int = 0;
            for (j=1; j<8; j+=2)
               tmp_int += req_sw[j].func_sw_state[i];
            if (tmp_int < 4)
               continue;
            for (j=8; j<req_sw_cnt; j+=2)
               tmp_int += req_sw[j].func_sw_state[i];
            if (tmp_int < 22)
               continue;
            tmp_long_int = atol(cur_log_rec.time_str);
            evnt_desc.evnt_label.end_tim = tmp_long_int/30000.0;
            chk_on_off = TRUE;
            continue;
         } /* Turning on required switch */
      } /* Required switches must be on */

      if (evnt_desc.no_var != 0)
      { /* Assume console assignment */
         evnt_desc.variant[0].tim_win =
evnt_desc.evnt_label.tim_win;
```

```
      evnt_desc.variant[0].strt_tim =
evnt_desc.evnt_label.strt_tim;
      switch_chk(&evnt_desc.variant[0]);
      if (evnt_desc.variant[0].end_tim != 0.0)
         evnt_desc.evnt_label.end_tim =
evnt_desc.variant[0].end_tim;
   } /* Assume console assignment */
} /* Cycle all WDs */
if (evnt_desc.evnt_label.strt_tim != 0.0 &&
evnt_desc.evnt_label.end_tim != 0.0)
{ /* Console checkout complete */
   clear();
   elap_tim = evnt_desc.evnt_label.end_tim -
evnt_desc.evnt_label.strt_tim;
   move(y_mid, 10);
   printw("Console Checkout Completed (%f sec)", elap_tim);
   tmp_flt = elap_tim - evnt_desc.evnt_label.tim_win;
   move(y_mid+1, 15);
   if (tmp_flt <= 0.0)
   { /* Within window */
      printw("%f sec. within %f sec. window", tmp_flt,
        evnt_desc.evnt_label.tim_win);
   } /* Within window */
   else
   { /* Outside window */
      printw("%f sec. outside of %f sec. window", tmp_flt,
        evnt_desc.evnt_label.tim_win);
   } /* Outside window */
   getch();
} /* Console checkout complete */
return;
} /* Evaluate CONSOLE CHECKOUT */
```

```
void switch_chk(struct evnt_var *swt_ent)
{ /* Evaluate switch action */
extern struct evnt_skelt evnt_desc;
extern struct log_rec cur_log_rec;
extern int wd_cnt;
extern char wd_console_no[];
extern FILE *pass6_fp;
extern struct evnt_var prev_swt;
extern long int prev_rec_pos;

extern void read_log();
extern void csl_chk();
extern void cmt_chk();
extern void win_chk();
extern void wmc_chk();

int i;
int valid;
long int rec_pos;
char mod_name[10];
int key_code, on_off_state;
int tmp_int;
unsigned int tmp_long_int;
float tmp_flt;
float elap_tim;
int swt_err_cnt;

rec_pos = ftell(pass6_fp);
if (prev_rec_pos < 0 || prev_rec_pos > rec_pos)
   prev_rec_pos = rec_pos;
swt_ent->end_tim = 0.0;
for (i=0; i<wd_cnt; i++)
{ /* Process switch action */
   fseek(pass6_fp, rec_pos, SEEK_SET);
   swt_err_cnt = 0;
   strcpy(mod_name, "Switch_x");
   mod_name[7] = wd_console_no[i];
   valid = FALSE;
   while (!valid)
   { /* Search for starting switch selection */
      read_log();
      if (strlen(cur_log_rec.time_str) == 0)
      { /* End of file or error */
         clear();
         cntr_ln(y_mid, "EOF/error in Logger: switch_chk");
         getch();
         fseek(pass6_fp, rec_pos, SEEK_SET);
         return;
      } /* End of file or error */
      if (swt_ent->strt_tim != 0.0)
      { /* Time constraint search */
         tmp_long_int = atol(cur_log_rec.time_str);
         tmp_flt = tmp_long_int/30000.0;
```

```
         if ((tmp_flt - swt_ent->strt_tim) > swt_ent->tim_win)
         { /* Check if same follow-on switch action */
            if (strcmp(prev_swt.name_fld, swt_ent->name_fld) ==
0)
            { /* Same follow-on switch action */
               fseek(pass6_fp, prev_rec_pos, SEEK_SET);
               valid = TRUE;
               continue;
            } /* Same follow-on switch action */
            return;
         } /* Check if same follow-on switch aciton */
      } /* Time constraint search */
      if (strcmp(cur_log_rec.mod_str, mod_name) != 0 ||
         strcmp(cur_log_rec.key_str, "101") != 0)
          continue;
      if ((strncmp(swt_ent->nbr_fld, cur_log_rec.trns_str,
         strlen(swt_ent->nbr_fld)) != 0) ||
         cur_log_rec.trns_str[strlen(swt_ent->nbr_fld)] != ' ')
          continue;
       if (swt_ent->strt_tim == 0.0)
       { /* Get start time */
         tmp_long_int = atol(cur_log_rec.time_str);
         swt_ent->strt_tim = tmp_long_int/30000.0;
       } /* Get start time */
       valid = TRUE;
   } /* Search for starting switch selection */

   swt_ent->end_tim = 0.0;
   strcpy(mod_name, "Display_x");
   mod_name[8] = wd_console_no[i];
   valid = FALSE;
   while (!valid)
   { /* Search for switch action completion */
      read_log();
      if (strlen(cur_log_rec.time_str) == 0)
      { /* End of file or error */
         clear();
         cntr_ln(y_mid, "EOF/error in Logger: switch_chk");
         getch();
         fseek(pass6_fp, rec_pos, SEEK_SET);
         return;
      } /* End of file or error */
      tmp_long_int = atol(cur_log_rec.time_str);
      tmp_flt = tmp_long_int/30000.0;
      if ((tmp_flt - swt_ent->strt_tim) > swt_ent->tim_win)
      { /* Switch action not completed in time */
         clear();
         move(y_mid, 10);
         printw("%s not completed in %f sec. (%d errors)",
swt_ent->name_fld,
           swt_ent->tim_win, swt_err_cnt);
         getch();
         valid = TRUE;
         continue;
```

```
      } /* Switch action not completed in time */
      if (strcmp(cur_log_rec.mod_str, mod_name) != 0 ||
        strcmp(cur_log_rec.key_str, "848") != 0)
         continue;
      if (strncmp(cur_log_rec.trns_str,
        swt_ent->alt_nm_fld, strlen(swt_ent->alt_nm_fld)) != 0)
         continue;
      if (cur_log_rec.trns_str[strlen(swt_ent->alt_nm_fld)+1] !=
'2')
      { /* Input error */
         swt_err_cnt++;
         continue;
      } /* Input error */
      tmp_long_int = atol(cur_log_rec.time_str);
      swt_ent->end_tim = tmp_long_int/30000.0;
      elap_tim = swt_ent->end_tim - swt_ent->strt_tim;
      clear();
      move(y_mid,10);
      printw("%s COMPLETED (%f sec) (%d errors)",
swt_ent->name_fld, elap_tim,
        swt_err_cnt);
      tmp_flt = elap_tim - swt_ent->tim_win;
      move(y_mid+1,15);
      if (tmp_flt <= 0.0)
      { /* Within window */
         printw("%f sec. within %f sec. window", tmp_flt,
swt_ent->tim_win);
      } /* Within window */
      else
      { /* Outside window */
         printw("%f sec. outside %f sec. window", tmp_flt,
swt_ent->tim_win);
      } /* Outside window */
      getch();

      /* Save last processed switch action */
      prev_rec_pos = ftell(pass6_fp);
      strcpy(prev_swt.name_fld, swt_ent->name_fld);
      strcpy(prev_swt.nbr_fld, swt_ent->nbr_fld);
      strcpy(prev_swt.alt_nm_fld, swt_ent->alt_nm_fld);
      strcpy(prev_swt.add_mtch_txt, swt_ent->add_mtch_txt);
      prev_swt.tim_win = swt_ent->tim_win;
      prev_swt.strt_tim = swt_ent->strt_tim;
      prev_swt.end_tim = swt_ent->end_tim;

      if (strcmp(swt_ent->alt_nm_fld, "CSL") == 0)
         csl_chk(i);
      if (strcmp(swt_ent->alt_nm_fld, "CMT") == 0)
         cmt_chk();
      if (strcmp(swt_ent->alt_nm_fld, "WIN") == 0)
         win_chk();
      if (strcmp(swt_ent->alt_nm_fld, "WMC") == 0)
         wmc_chk();
      valid= TRUE;
```

```
   } /* Search for switch action completion */
} /* Process switch action */
return;
} /* Evaluate switch action */
```

```
void csl_chk(int ndx)
{ /* Evaluate Assign Console Switch */
extern struct log_rec cur_log_rec;
extern int wd_cnt;
extern char wd_id_no[];

if (strlen(cur_log_rec.trns_str) == 6)
{ /* Assign console TD */
   move(y_mid+2, 0);
   clrtoeol();
   mvinsstr(y_mid+2, 15, "Assign Console TD requested");
   getch();
   return;
} /* Assign console TD */
if (strncmp(&cur_log_rec.trns_str[6], "WD", 2) != 0)
{ /* Error - Station type */
   move(y_mid+2, 0);
   clrtoeol();
   mvinsstr(y_mid+2, 15, "Error: (CSL) Station type
specification");
   getch();
} /* Error - Station type */
if (cur_log_rec.trns_str[9] != wd_id_no[ndx])
{ /* Error - Position number */
   move(y_mid+2, 0);
   clrtoeol();
   mvinsstr(y_mid+2, 15, "Error: (CSL) Position number
specification");
   getch();
} /* Error - Position number */
return;
} /* Evaluate Assign Console Switch */
```

```
void cmt_chk()
{ /* Evaluate Commit Switch */
extern struct log_rec cur_log_rec;

extern void left_just();

int i, j;
char *brkt;
int ndx;
char cmt_str[80];
char obj_str[5];
char tgt_str[5];
int tgt_fnd;
char * blnk;
char cmt_type, cmt_intercept;

strcpy(cmt_str, cur_log_rec.trns_str);
for (i=0; i<strlen(cmt_str); i++)
{ /* Eliminate "hook" character */
   if (cmt_str[i] != '\x9f')
      continue;
   cmt_str[i] = ' ';
   brkt = strchr(&cmt_str[i], '}');
   ndx = brkt - cmt_str;
   for (j=i; j<ndx-4; j++)
      cmt_str[j] = ' ';
   cmt_str[ndx] = ' ';
   left_just(&cmt_str[i]);
} /* Eliminate "hook" character */

strncpy(obj_str, &cmt_str[6], 4);
obj_str[4] = '\0';

for (i=6; i<10; i++)
   cmt_str[i] = ' ';
left_just(&cmt_str[6]);

ndx = 6;
tgt_fnd = FALSE;
tgt_str[0] = '\0';
while (!tgt_fnd)
{ /* Search for target */
   if (strlen(&cmt_str[ndx]) < 4)
   { /* No string */
      tgt_fnd = TRUE;
      continue;
   } /* No string */
   blnk = strchr(&cmt_str[ndx], ' ');
   if (blnk == NULL)
   { /* End of "cmt_str" */
      if (strlen(&cmt_str[ndx]) == 4)
      { /* Assume target */
         strncpy(tgt_str, &cmt_str[ndx], 4);
```

```
            tgt_str[4] = '\0';
         } /* Assume target */
         tgt_fnd = TRUE;
         continue;
      } /* End of "cmt_str" */
      if ((blnk - &cmt_str[ndx]) < 3)
      { /* Not target */
         ndx += ((blnk - &cmt_str[ndx]) +1);
         continue;
      } /* Not target */
      strncpy(tgt_str, &cmt_str[ndx], 4);
      tgt_str[4] = '\0';
      tgt_fnd = TRUE;
   } /* Search for target */

   if (strlen(tgt_str) != 0)
   { /* Shorten string */
      for (i=ndx; i<ndx+4; i++)
         cmt_str[i] = ' ';
      left_just(&cmt_str[ndx]);
   } /* Shorten string */

   cmt_type = 'D';
   cmt_intercept = 'C';
   for (i=6; i<strlen(cmt_str); i++)
   { /* Get Commit type & intercept */
      if (isspace(cmt_str[i]))
         continue;
      if (cmt_str[i] == 'I' || cmt_str[i] == 'D')
         cmt_type = cmt_str[i];
      else
         cmt_intercept = cmt_str[i];
   } /* Get Commit type & intercept */
   move(y_mid+2, 15);
   clrtoeol();
   printw("%s committed on %s using", obj_str, tgt_str);
   move(y_mid+3, 15);
   clrtoeol();
   printw("Intercept geometry: %c Mission: %c", cmt_intercept,
   cmt_type);
   getch();

   return;
   } /* Evaluate Commit Switch */
```

```
void win_chk()
{ /* Evaluate Init Switch Action */
extern struct log_rec cur_log_rec;

extern void read_log();

int crrlt;
char cor_obj[5];

crrlt = FALSE;
while (!crrlt)
{ /* Find correlation */
   read_log();
   if (strcmp(cur_log_rec.mod_str, "starget_1") != 0 ||
     strcmp(cur_log_rec.key_str, "845") != 0)
      continue;
   strcpy(cor_obj,
&cur_log_rec.trns_str[strlen(cur_log_rec.trns_str)-4]);
   crrlt = TRUE;
} /* Find correlation */

move(y_mid+2, 15);
printw("%s was initiated", cor_obj);
getch();

return;
} /* Evaluate Init Switch Action */
```

```
void wmc_chk()
{ /* Evaluate Mode IV Switch Action */
extern struct log_rec cur_log_rec;

char *brkt;
int ndx;
char mode_obj[5];

if (strchr(cur_log_rec.trns_str, '\x9f') != NULL)
{ /* Find object */
   brkt = strchr(cur_log_rec.trns_str, '}');
   ndx = brkt - cur_log_rec.trns_str - 4;
   strncpy(mode_obj, &cur_log_rec.trns_str[ndx], 4);
   mode_obj[4] = '\0';
} /* Find object */
else
   return;

move(y_mid+2,15);
printw("Mode IV check on %s", mode_obj);
getch();
return;
} /* Evaluate Mode IV Switch Action */
```

```
void multi_switch()
{ /* Evaluate switch sequence variations */
extern struct evnt_skelt evnt_desc;
extern int wd_cnt;
extern char wd_console_no[];
extern char wd_id_no[];
extern FILE *pass6_fp;
extern struct log_rec cur_log_rec;
extern long int prev_evnt_strt_rec;

int i, j, k;
long int rec_pos;
char mod_name[10];
int valid;
int strt_ent;
unsigned int tmp_long_int;
float elap_tim;

rec_pos = ftell(pass6_fp);
if (prev_evnt_strt_rec < 0 || prev_evnt_strt_rec > rec_pos)
   prev_evnt_strt_rec = rec_pos;
else
   rec_pos = prev_evnt_strt_rec;
for (i=0; i<wd_cnt; i++)
{ /* Process switch sequences */
   fseek(pass6_fp, rec_pos, SEEK_SET);
   strcpy(mod_name, "Display_x");
   mod_name[8] = wd_console_no[i];
   valid = FALSE;
   while (!valid)
   { /* Find start */
      read_log();
      if (strcmp(cur_log_rec.mod_str, mod_name) != 0 ||
        strcmp(cur_log_rec.key_str, evnt_desc.evnt_label.nbr_fld)
!= 0 ||
        strncmp(cur_log_rec.trns_str,
evnt_desc.evnt_label.add_mtch_txt,
          strlen(evnt_desc.evnt_label.add_mtch_txt)) != 0)
         continue;
      tmp_long_int = atol(cur_log_rec.time_str);
      evnt_desc.evnt_label.strt_tim = tmp_long_int/30000.0;
      rec_pos = ftell(pass6_fp);
      prev_evnt_strt_rec = rec_pos;
      valid = TRUE;
   } /* Find start */

   strt_ent = 0;
   for (j=0; j<evnt_desc.no_var; j++)
   { /* Process a switch sequence */
      fseek(pass6_fp, rec_pos, SEEK_SET);
      for (k=strt_ent; k<strt_ent+evnt_desc.step_per_var[j]; k++)
      { /* Variation j */
         evnt_desc.variant[k].strt_tim =
```

```
evnt_desc.evnt_label.strt_tim;
         evnt_desc.variant[k].tim_win =
evnt_desc.evnt_label.tim_win;
         switch_chk(&evnt_desc.variant[k]);
         if (evnt_desc.variant[k].end_tim == 0.0)
         { /* Switch start not found */
            break;
         } /* Switch start not found */
         evnt_desc.evnt_label.end_tim =
evnt_desc.variant[k].end_tim;
      } /* Variation j */
      if (evnt_desc.evnt_label.end_tim == 0.0)
      { /* Start not found */
         strt_ent += evnt_desc.step_per_var[j];
         continue;
      } /* Start not found */
      elap_tim = evnt_desc.evnt_label.end_tim -
evnt_desc.evnt_label.strt_tim;
      clear();
      move(y_mid,10);
      printw("%s Completed (%f sec)",
evnt_desc.evnt_label.name_fld, elap_tim);
      getch();
      break;
   } /* Process a switch sequence */
   if (evnt_desc.evnt_label.end_tim == 0.0)
   { /* Event not found */
      clear();
      move(y_mid,10);
      printw("%s Not Found", evnt_desc.evnt_label.name_fld);
      getch();
   } /* Event not found */
} /* Process switch sequences */
return;
} /* Evaluate switch sequence variations */
```

```
NAME:  ITS.C

#include <curses.h>
#include <string.h>

#include "itsdef.h"

main()
{ /* Intelligent Tutor */
extern int x_mid;
extern int y_mid;
extern char instr_path[];
extern instruct_blk_open;
extern char stdt_path[];
extern int instr_review;
extern int user_type;
extern int first_ques;

int pick;
int x_coord, y_coord;
int rtn_state;
char buf[81];

/*****************************************************************************
   Initialize window for Intelligent Tutor interface
      VT100: no action is required to establish a window.
      IRIS: "wsh -n 'ITS Menu' -p2,2 -s113,52" is used to establish a
         full screen window.
*****************************************************************************/

   initscr();

/*****************************************************************************
   Gain control of keyboard
*****************************************************************************/

   cbreak();    /* Pass all keystroke to program */
   noecho();    /* Suppress character echoing */
   nonl();      /* Suppress carriage return recognition */
   keypad(stdscr,TRUE);    /* Access user's keypad */

/*****************************************************************************
   Instructor/Student function selection
*****************************************************************************/

   x_mid = COLS/2 - 1;
   y_mid = LINES/2 - 1;
   instr_path[0] = '\0';
   instruct_blk_open = FALSE;
   stdt_path[0] = '\0';
   instr_review = -1;
   first_ques = -1;

   cntr_ln(y_mid - 2, "Use cursor to select:");
```

```
   attrset(A_STANDOUT);
   mvaddstr(y_mid, x_mid - 10, "Instructor");
   attrset(0);
   mvaddstr(y_mid, x_mid + 3, "Student");
   cntr_ln(y_mid + 2, "then press 'Enter'");
   move(y_mid, x_mid - 10);

/*************************************************************************
   Move and highlight appropriate field according to cursor use, then
   retrive desired selection.
*************************************************************************/

   for (;;)
   { /* Wait for Instructor/Student selection */
      x_coord = 0;
      y_coord = 0;
      pick = getch();
      switch(pick)
      { /* Examine keyboard input */
      case KEY_LEFT:
         attrset(A_STANDOUT);
         mvaddstr(y_mid, x_mid - 10, "Instructor");
         attrset(0);
         mvaddstr(y_mid, x_mid + 3, "Student");
         move(y_mid, x_mid - 10);
         break;

      case KEY_RIGHT:
         attrset(0);
         mvaddstr(y_mid, x_mid - 10, "Instructor");
         attrset(A_STANDOUT);
         mvaddstr(y_mid, x_mid + 3, "Student");
         attrset(0);
         move(y_mid, x_mid + 3);
         break;

      case '\r':
      case 0x157:
         getyx(stdscr,y_coord,x_coord);
         break;

      default:
         break;
      } /* Examine keyboard input */
   if (x_coord != 0)
      break;
   } /* Wait for Instructor/Student selection */

   if (x_coord == x_mid - 10)
   { /* Instructor */
      getstr(buf);
      if (strcmp("password",buf) != 0)
      { /* Feeble attempt at security */
         endwin();
```

```
            exit(0);
         } /* Feeble attempt at security */
         user_type = Instructor;
         rtn_state = 1;
         while (rtn_state != 0)
         { /* Continue to call */
            instructor(&rtn_state);
            if (instr_review >= 0)
            { /* Review an instruction block */
               student(&rtn_state);
               instr_review = -1;
            } /* Review an instruction block */
         } /* Continue to call */
      } /* Instructor */

      else
      { /* Student */
         user_type = Student;
         student(&rtn_state);
         if (rtn_state == 0)
            its_stop();
         clear();
         refresh();
      } /* Student */

      endwin();
      exit(0);

} /* Intelligent Tutor */
```

NAME: ITSDEF.H

```
/*************************************************************************
   Common variables
*************************************************************************/
#define Instructor 157
#define Student 208
#define instr_path_def "/usr/people/neal/instructor"
#define stdt_path_def "/usr/people/neal/student"

int user_type;   /* Indicator of user type (Instructor/Student) */
int x_mid;       /* x coordinate of screen center */
int y_mid;       /* y coordinate of screen center */

/*************************************************************************
   Variables for Instructor
*************************************************************************/
char instr_path[80];   /* Directory string to Instructor files */
int instruct_blk_open; /* Indicator that file open and in memory */
int instr_blk_cnt;     /* Count of exiting instruction blocks */
int instr_review;      /* If >= 0 then curricula review occuring   */
                       /* & value is entry index into instruct.blk */

FILE *lesson_fp;   /* Declare file pointer for lesson block */

/*************************************************************************
   Structure for a block of instruction
      Each occurrence of "curricula" repesents a block of instruction
         title = brief description
         no_qa_sets = number of Q&A sets in this instructional block
         qa_sets = each occurrence is a file containing one or more
                   related Q&As.
*************************************************************************/
struct filnms
{ /* 10 character fields */
   char names[10];   /* Name of a lesson file */
};/* 10 character fields */

struct curricula
{ /* Lesson blk record */
   char title[80];            /* Brief description of instruction block */
   int no_qa_sets;            /* Number of lessons in instruction block */
   struct filnms qa_sets[50]; /* Names of lessons in instruction block */
};/* Lesson blk record */

struct curricula instr_blks[50];

/*************************************************************************
   Variables for Student
*************************************************************************/
char stdt_path[80];    /* Directory string to Student files */
FILE *student_fp;   /* Declare file pointer for student profile */
FILE * present_fp;   /* Declare file pointer for lesson presentation */
```

```
int stdt_acc_score;   /* Student's accumulated score */
int first_ques;   /* Index of 1st question in a lesson */

/*************************************************************************
   Structure for a student's data base
*************************************************************************/
struct level
{
   int max_val;   /* Maximum value accumulation */
   int min_val;   /* Minimum value accumulation */
   int act_val;   /* Actual value accumulation */
   int spare_val;   /* Spare */
};

struct stdt_db
{ /* Student's DB */
   char ssan[9];         /* SSAN */
   char name[26];        /* Name */
   int instr_blk_ndx;    /* Index into instr_blks */
   int lesson_ndx;       /* Index of lesson in instr_blks entry */
   int text_blk_ndx;     /* Numeric id of text to be presented */
   int know_phase_ndx;   /* Knowledge level/phase index */
   struct level know_phase[5];
};/* Student's DB */

struct stdt_db pupil;

struct ans_val_entry
{ /* Entry for multiple choice */
   char ans_desig;   /* Designation of answer, e.g. a,b,c...,or 1,2,3,...
*/
   int ans_val;   /* Value of the answer */
};/* Entry for multiple choice */

struct lesson_file_entry
{ /* Entry in lesson file map */
   int num_id;     /* Numeric identifier of text */
   int text_type;  /* Type of text */
   long int file_pos;   /* Offset from start of file */
   int prev_num_id;   /* Numeric id of previous text */
   int know_level[5];   /* The follow-on text for each knowledge level */
                        /* and correspond to the num_id of the text.   */
   int mc_ans_cnt;   /* Number of entries in mc_ans */
   struct ans_val_entry mc_ans[8];
   char stdt_ans;
};/* Entry in lesson file map */

struct lesson_file_entry lesson_map[200];
```

```
NAME:   ITS_RUTN.CWP

#include <curses.h>    /* <stdio.h>, <termio.h>, <unctrl.h> */
#include <unistd.h>
#include <errno.h>
#include <string.h>

#include "itsdef.h"
```

```
void cntr_ln(int y_coord, char *txt_str)
{ /* cntr_ln */
extern int x_mid;
extern int y_mid;

int i, x_offset;

   x_offset = 0;
   for (i=0; i<=strlen(txt_str)-1; i++)
   { /* Search for printable characters */
      if (isprint(*(txt_str+i)))
         x_offset++;
   } /* Search for printable characters */
   x_offset /= 2;
   mvaddstr(y_coord, x_mid - x_offset, txt_str);
   return;

} /* cntr_ln */
```

```
void get_path_str(char * directory, char * path_str)
{ /* Get path to specified directory */
extern int x_mid;
extern int y_mid;

int reply;
char buf[80];

   if (strlen(path_str) != 0)
   { /* Directory path already specified */
      return;
   } /* Directory path already specified */

   strcpy(buf, "Enter path to \"");
   strcat(buf, directory);
   strcat(buf, "\" file directory");
   clear();
   cntr_ln(y_mid-1, buf);
   mvaddstr(y_mid, x_mid-(strlen(buf)/2), "->");
   move(y_mid, x_mid-(strlen(buf)/2)+3);

   while (TRUE)
   { /* Get directory path */
      echo();
      clrtoeol();
      getstr(path_str);
      noecho();
      if (strlen(path_str) == 0)
      { /* Use default path */
         move(y_mid, x_mid-(strlen(buf)/2)+3);
         if (strcmp(directory, "Instructor") == 0)
         { /* Use instructor path default */
            addstr(instr_path_def);
            strcpy(path_str, instr_path_def);
         } /* Use instructor path default */
         else
         { /* Use student path default */
            addstr(stdt_path_def);
            strcpy(path_str, stdt_path_def);
         } /* Use student path default */
         refresh();
      } /* Use default path */
      cntr_ln(y_mid+2, "Is path correct? [Y/N/Q]: ");
      reply = tolower(getch());
      if (reply == 'y')
         break;
      if (reply == 'q')
      { /* Terminate process */
         *path_str = '\0';   /* Set NULL string */
         break;
      } /* Terminate process */
      move(y_mid+2, 0);
      clrtoeol();
```

```
        refresh();
        move(y_mid, x_mid-(strlen(buf)/2)+3);
    } /* Get directory path */

    clear();
    refresh();
    return;

} /* Get path to specified directory */
```

```
void file_str(char *path, char *filename, char *fullstr)
{ /* Form full filestring */
int trim;
char *blank_ptr;

   strcpy(fullstr, path);
   strcat(fullstr,"/");
   strcat(fullstr,filename);
   trim = TRUE;
   while (trim)
   { /* Trim of trailing blanks */
      blank_ptr = strrchr(fullstr, ' ');
      if (blank_ptr == NULL)
      { /* Blanks trimmed off */
         trim = FALSE;
         continue;
      } /* Blanks trimmed off */
      fullstr[blank_ptr-fullstr] = NULL;
   } /* Trim of trailing blanks */
   return;
} /* Form full filestring */
```

```
void its_stop()
{ /* Halt ITS unconditionally */
   endwin();
   exit(0);
} /* Halt ITS unconditionally */
```

```
int chk_file(char *path, char *filename)
{ /* Check accessibility */
extern int x_mid;
extern int y_mid;
extern int user_type;

int reply;
int status;
char fullstr[80], txtstr[80];

   file_str(path, filename, fullstr);
   status = access(fullstr, F_OK);
   if (status == 0) return(0);
   clear();
   if (errno == ENOTDIR)
      printw("Path specification error in \"%s\"", path);
   else if (errno == ENOENT)
   { /* File does not exist */
      if (user_type == Student)
         return(1);
      clear();
      sprintf(txtstr, "File \"%s\" does not exist", fullstr);
      cntr_ln(y_mid-1, txtstr);
      cntr_ln(y_mid, "Continue [Y/N]: ");
      reply = tolower(getch());
      if (reply == 'y')
      { /* Indicate condition */
         clear();
         refresh();
         return(1);
      } /* Indicate condition */
   } /* File does not exits */
   else
      printw("File access denied w/ errno = %d", errno);
   refresh();
   its_stop();

} /* Check accessibility */
```

```
void lesson_blk_io(char io_type, int ndx)
{ /* Provide I/O for lesson block file */
extern FILE *lesson_fp;

char shrt_str[81];
char rec_str[635];
int offset;
int i;

   if (tolower(io_type) == 'w')
   { /* Write a record of lesson block */
      sprintf(rec_str, "%s|%02d", instr_blks[ndx].title,
         instr_blks[ndx].no_qa_sets);
      for (i=0; i<50; i++)
      { /* Format qa file names */
         strcat(rec_str, "|");
         strncat(rec_str, instr_blks[ndx].qa_sets[i].names, 10);
      } /* Format qa file names */
      strcat(rec_str,"\n");
      fseek(lesson_fp, 634*ndx, SEEK_SET);
      fputs(rec_str, lesson_fp);
   } /* Write a record of lesson block */

   else if (tolower(io_type) == 'r')
   { /* Read a record of lesson block */
      fseek(lesson_fp, 634*ndx, SEEK_SET);
      fgets(rec_str, 634, lesson_fp);

      strncpy(instr_blks[ndx].title, rec_str, 80);
      offset = 81;
      sscanf(&rec_str[offset], "%2d", &instr_blks[ndx].no_qa_sets);
      offset += 3;
      for (i=0; i<50; i++)
      { /* Unblock qa file names */
         strncpy(instr_blks[ndx].qa_sets[i].names, &rec_str[offset], 10);
         offset += 11;
      } /* Unblock qa file names */
   } /* Read a record of lesson block */

   else
   { /* Error in I/O specification */
      clear();
      addstr("lesson_blk_io error: I/O type specification");
      refresh();
      its_stop();
   } /* Error in I/O specification */
   return;

} /* Provide I/O for lesson block file */
```

```
void work_msg()
{ /* Present blinking 'working...' message */
   clear();
   attrset(A_BLINK);
   cntr_ln(y_mid, "Working...");
   attrset(0);
   refresh();
   return;
} /* Present blinking 'working...' message */
```

```
void getstr_echo(char *str)
{ /* Enable character echoing with getstr function */
   echo();
   getstr(str);
   noecho();
} /* Enable character echoing with getstr function */
```

```
void strg_blnk_pad(char *strng, int str_len)
{ /* Pad a left justified string with blanks */
int i;

   if (strlen(strng) > str_len)
   {
      cntr_ln(22, "String too long");
      cntr_ln(23, "Press any key to continue");
      getch();
      return;
   }

   if (strlen(strng) < str_len)
   { /* Pad with blanks */
      for (i=strlen(strng); i<str_len; i++)
         strng[i] = ' ';
   } /* Pad with blanks */
   return;

} /* Pad a left justified string with blanks */
```

```
NAME:  ITS_RUTN.C

#include <curses.h>    /* <stdio.h>, <termio.h>, <unctrl.h> */
#include <unistd.h>
#include <errno.h>
#include <string.h>

#include "itsdef.h"
```

```
void cntr_ln(int y_coord, char *txt_str)
{ /* cntr_ln */
extern int x_mid;
extern int y_mid;

int i, x_offset;

   x_offset = 0;
   for (i=0; i<=strlen(txt_str)-1; i++)
   { /* Search for printable characters */
      if (isprint(*(txt_str+i)))
         x_offset++;
   } /* Search for printable characters */
   x_offset /= 2;
   mvaddstr(y_coord, x_mid - x_offset, txt_str);
   return;

} /* cntr_ln */
```

```
void get_path_str(char * directory, char * path_str)
{ /* Get path to specified directory */
extern int x_mid;
extern int y_mid;

int reply;
char buf[80];

   if (strlen(path_str) != 0)
   { /* Directory path already specified */
      return;
   } /* Directory path already specified */

   strcpy(buf, "Enter path to \"");
   strcat(buf, directory);
   strcat(buf, "\" file directory");
   clear();
   cntr_ln(y_mid-1, buf);
   mvaddstr(y_mid, x_mid-(strlen(buf)/2), "->");
   move(y_mid, x_mid-(strlen(buf)/2)+3);

   while (TRUE)
   { /* Get directory path */
      echo();
      clrtoeol();
      getstr(path_str);
      noecho();
      if (strlen(path_str) == 0)
      { /* Use default path */
         move(y_mid, x_mid-(strlen(buf)/2)+3);
         if (strcmp(directory, "Instructor") == 0)
         { /* Use instructor path default */
            addstr(instr_path_def);
            strcpy(path_str, instr_path_def);
         } /* Use instructor path default */
         else
         { /* Use student path default */
            addstr(stdt_path_def);
            strcpy(path_str, stdt_path_def);
         } /* Use student path default */
         refresh();
      } /* Use default path */
      cntr_ln(y_mid+2, "Is path correct? [Y/N/Q]: ");
      reply = tolower(getch());
      if (reply == 'y')
         break;
      if (reply == 'q')
      { /* Terminate process */
         *path_str = '\0';   /* Set NULL string */
         break;
      } /* Terminate process */
      move(y_mid+2, 0);
      clrtoeol();
```

```
      refresh();
      move(y_mid, x_mid-(strlen(buf)/2)+3);
   } /* Get directory path */

   clear();
   refresh();
   return;

} /* Get path to specified directory */
```

```
void file_str(char *path, char *filename, char *fullstr)
{ /* Form full filestring */
int trim;
char *blank_ptr;

   strcpy(fullstr, path);
   strcat(fullstr,"/");
   strcat(fullstr,filename);
   trim = TRUE;
   while (trim)
   { /* Trim of trailing blanks */
      blank_ptr = strrchr(fullstr, ' ');
      if (blank_ptr == NULL)
      { /* Blanks trimmed off */
         trim = FALSE;
         continue;
      } /* Blanks trimmed off */
      fullstr[blank_ptr-fullstr] = NULL;
   } /* Trim of trailing blanks */
   return;
} /* Form full filestring */
```

```
void its_stop()
{ /* Halt ITS unconditionally */
   endwin();
   exit(0);
} /* Halt ITS unconditionally */
```

```
int chk_file(char *path, char *filename)
{ /* Check accessibility */
extern int x_mid;
extern int y_mid;
extern int user_type;

int reply;
int status;
char fullstr[80], txtstr[80];

   file_str(path, filename, fullstr);
   status = access(fullstr, F_OK);
   if (status == 0) return(0);
   clear();
   if (errno == ENOTDIR)
      printw("Path specification error in \"%s\"", path);
   else if (errno == ENOENT)
   { /* File does not exist */
      if (user_type == Student)
         return(1);
      clear();
      sprintf(txtstr, "File \"%s\" does not exist", fullstr);
      cntr_ln(y_mid-1, txtstr);
      cntr_ln(y_mid, "Continue [Y/N]: ");
      reply = tolower(getch());
      if (reply == 'y')
      { /* Indicate condition */
         clear();
         refresh();
         return(1);
      } /* Indicate condition */
   } /* File does not exits */
   else
      printw("File access denied w/ errno = %d", errno);
   refresh();
   its_stop();

} /* Check accessibility */
```

```
void lesson_blk_io(char io_type, int ndx)
{ /* Provide I/O for lesson block file */
extern FILE *lesson_fp;

char shrt_str[81];
char rec_str[635];
int offset;
int i;

   if (tolower(io_type) == 'w')
   { /* Write a record of lesson block */
      sprintf(rec_str, "%s¦%02d", instr_blks[ndx].title,
         instr_blks[ndx].no_qa_sets);
      for (i=0; i<50; i++)
      { /* Format qa file names */
         strcat(rec_str, "¦");
         strncat(rec_str, instr_blks[ndx].qa_sets[i].names, 10);
      } /* Format qa file names */
      strcat(rec_str,"\n");
      fseek(lesson_fp, 634*ndx, SEEK_SET);
      fputs(rec_str, lesson_fp);
   } /* Write a record of lesson block */

   else if (tolower(io_type) == 'r')
   { /* Read a record of lesson block */
      fseek(lesson_fp, 634*ndx, SEEK_SET);
      fgets(rec_str, 634, lesson_fp);

      strncpy(instr_blks[ndx].title, rec_str, 80);
      offset = 81;
      sscanf(&rec_str[offset], "%2d", &instr_blks[ndx].no_qa_sets);
      offset += 3;
      for (i=0; i<50; i++)
      { /* Unblock qa file names */
         strncpy(instr_blks[ndx].qa_sets[i].names, &rec_str[offset], 10);
         offset += 11;
      } /* Unblock qa file names */
   } /* Read a record of lesson block */

   else
   { /* Error in I/O specification */
      clear();
      addstr("lesson_blk_io error: I/O type specification");
      refresh();
      its_stop();
   } /* Error in I/O specification */
   return;

} /* Provide I/O for lesson block file */
```

```
void work_msg()
{ /* Present blinking 'working...' message */
   clear();
   attrset(A_BLINK);
   cntr_ln(y_mid, "Working...");
   attrset(0);
   refresh();
   return;
} /* Present blinking 'working...' message */
```

```
void getstr_echo(char *str)
{ /* Enable character echoing with getstr function */
   echo();
   getstr(str);
   noecho();
} /* Enable character echoing with getstr function */
```

```
void strg_blnk_pad(char *strng, int str_len)
{ /* Pad a left justified string with blanks */
int i;

   if (strlen(strng) > str_len)
   {
      cntr_ln(22, "String too long");
      cntr_ln(23, "Press any key to continue");
      getch();
      return;
   }

   if (strlen(strng) < str_len)
   { /* Pad with blanks */
      for (i=strlen(strng); i<str_len; i++)
         strng[i] = ' ';
   } /* Pad with blanks */
   return;

} /* Pad a left justified string with blanks */
```

```
NAME:  INSTRUCT.C

#include <curses.h>
#include <string.h>
#include "itsdef.h"

void instructor(int *rtn_state)
{ /* Instructor */
   extern int x_mid;
   extern int y_mid;
   extern struct curricula instr_blks[];
   extern FILE *lesson_fp;
   extern char instr_path[];
   extern instruct_blk_open;
   extern instr_blk_cnt;
   extern instr_review;

   int pick, valid, select, reply, reply1;
   int file_state;
   int i,j,k;
   int x_pos, y_pos;

   char filestr[80];
   char any_str[81];


/*************************************************************************
   Present Instructor's Menu
*************************************************************************/

   clear();
   cntr_ln(y_mid - 4, "Enter index of desired option:\n");
   mvaddstr(y_mid - 2, x_mid - 13, "1. Add an instruction block");
   mvaddstr(y_mid - 1, x_mid - 13, "2. Delete an instruction block");
   mvaddstr(y_mid, x_mid - 13, "3. Modify an instruction block");
   mvaddstr(y_mid + 1, x_mid - 13, "4. Review an instruction block");
   mvaddstr(y_mid + 2, x_mid - 13, "5. Review a student's performance");
   mvaddstr(y_mid + 3, x_mid - 13, "6. Adjust a student's instruction");
   cntr_ln(y_mid + 5, "Selection:");
   move(y_mid + 5, x_mid + 6);

/*************************************************************************
   Get selection
*************************************************************************/

   valid = FALSE;
   select = 0;
   while (!valid)
   { /* Examine user's selection */
      pick = getch();

      if (pick == '\r' || pick == 0x157)
      { /* Possible termination of input or process */
         if (select != 0)
```

```
      { /* Terminate selection process */
         valid = TRUE;
      } /* Terminate selection process */
      else
      { /* Check if process terminating */
         cntr_ln(y_mid+7, "Terminate ITS [Y/N]:");
         move(y_mid+7, x_mid+12);
         pick = tolower(getch());
         if (pick == 'y')
         { /* Terminate */
            clear();
            refresh();
            *rtn_state = 0;
            return;
         } /* Terminate */
         else
         { /* Continue selection process */
            move(y_mid+5, x_mid+6);
            clrtobot();
            select = 0;
         } /* Continue selection process */
      } /* Check if process terminating */
   } /* Possible termination of input or process */

   else if ((isalpha(pick)) || (pick <= 0x30 || pick > 0x36))
   { /* Invalid response */
      mvaddch(y_mid+5, x_mid+7,pick);
      cntr_ln(y_mid+7, "Invalid response");
      refresh();
      select = 0;
   } /* Invalid response */

   else
   { /* Valid reponse */
      valid = TRUE;
      select = pick;
      mvaddch(y_mid+5, x_mid+7, pick);
      *rtn_state = 1;
   } /* Valid response */
} /* Examine user's selection */

if ((select <= 0x34) && (!instruct_blk_open))
{ /* Get desired path */
   get_path_str("Instructor", instr_path);
   if (strlen(instr_path) == 0)
   { /* No path specified */
      *rtn_state = 0;   /* Terminate Instructor */
      return;
   } /* No path specified */

   file_state = chk_file(instr_path, "instruct.blk");
   file_str(instr_path, "instruct.blk", filestr);
   if (file_state == 0)
      lesson_fp = fopen(filestr, "r+");  /* Open existing file */
```

```
   else
      lesson_fp = fopen(filestr, "w+");  /* Open new file */

   if (lesson_fp == NULL)
   { /* Error */
      clear();
      printw("Error opening \"%s\"", filestr);
      refresh();
      its_stop();
   } /* Error */

   if (file_state != 0)
   { /* Initialize new file */
      work_msg();
      for (i=0; i<=49; i++)
      { /* Initialize instruction directory and file */
         lesson_blk_rec_init(i);
         lesson_blk_io('W', i);
      } /* Initialize instruction directory and file */
   } /* Initialize new file */

} /* Get desired path */

if (!instruct_blk_open)
{ /* File already in memory */
   work_msg();
   instr_blk_cnt = 0;
   for (i=0; i<50; i++)
   { /* Find available lesson blocks */
      lesson_blk_io('R', i);
      if (instr_blks[i].no_qa_sets != 0)
         instr_blk_cnt++;
   } /* Find available lesson blocks */
   instruct_blk_open = TRUE;
} /* File already in memory */

/* Check if list of instruction blocks is desired */
clear();
if (instr_blk_cnt == 0)
{ /* No list available */
   cntr_ln(y_mid+1, "No instruction blocks exist");
   cntr_ln(y_mid+2, "Press any key to continue");
   pick = getch();
   if (select != '1') return;
} /* No list available */

/* Process chosen option */
if (select == '1')
{ /* Adding an instruction block */
   pick = lesson_list(instr_blk_cnt);
   if (instr_blk_cnt == 0)
      pick = 0;
   else
      pick = instr_blk_cnt;
```

```
      /* Get a title */
      clear();
      mvaddstr(y_mid-1, 0, "Enter title (max = 80 chars):");
      move(y_mid+1, 0);
      getstr_echo(any_str);

      if (strlen(any_str) == 0)
      { /* Return to main menu */
         *rtn_state = 1;
         return;
      } /* Return to main menu */

      instr_blk_cnt++;
      strg_blnk_pad(any_str, 80);
      strncpy(instr_blks[pick].title, any_str, 80);

      /* Get list of associated lessons */
      clear();
      cntr_ln(y_mid-1, "Any lessons in this instruction block? [Y/N]:");
      reply = tolower(getch());

      if (reply == 'n')
      { /* Create a dummy entry */

strncpy(instr_blks[pick].qa_sets[instr_blks[pick].no_qa_sets].names,
            "dummy", 10);
         strg_blnk_pad(
            instr_blks[pick].qa_sets[instr_blks[pick].no_qa_sets].names,
10);
         instr_blks[pick].no_qa_sets++;
         lesson_blk_io('W', pick);
         return;
      } /* Create a dummy entry */

      instr_blk_vis(pick);
      valid = TRUE;
      select = 0;
      while (valid)
      { /* Get lesson filenames */
         make_pos(select, &y_pos, &x_pos);
         mvaddstr(23, 0, "Enter lesson name (max = 10 char):");
         move(23, 34);
         getstr_echo(any_str);
         if (strlen(any_str) == 0) continue;
         if (strlen(any_str) == 1 && (any_str[0] == 'q' || any_str[0] ==
'Q'))
         { /* Exiting */
            lesson_blk_io('W', pick);
            valid = FALSE;
            break;
         } /* Exiting */
         if (strlen(any_str) > 10)
         { /* String too long */
```

```
            move(23,50);
            addstr("Too long");
            getch();
            move(23,34);
            clrtoeol();
            refresh();
            continue;
         } /* String too long */
         mvaddstr(y_pos, x_pos, any_str);
         refresh();
         strg_blnk_pad(any_str, 10);
         strncpy(instr_blks[pick].qa_sets[select].names, any_str, 10);
         instr_blks[pick].no_qa_sets++;
         select++;
         move(23,34);
         clrtoeol();
         refresh();
      } /* Get lesson filenames */

} /* Adding an instruction block */

else if (select == '2')
{ /* Deleting an instruction block */
   pick = lesson_list(instr_blk_cnt);
   instr_blk_vis(pick);
   mvaddstr(23, 0, "Do you want to delete lessons? [Y/N]:");
   reply = tolower(getch());
   if (reply == 'y')
   { /* Determine complete or selective deletion */
      move(23,0);
      clrtoeol();
      addstr("Delete (a)ll or (s)ome of these lessons?");
      reply = tolower(getch());

      if (reply == 'a')
      { /* Delete all lessons */
         for (i=0; i<instr_blks[pick].no_qa_sets; i++)
         { /* Get lesson file */
            strcpy(any_str, instr_path);
            strcat(any_str, "/");
            strncat(any_str, instr_blks[pick].qa_sets[i].names, 10);
            any_str[strlen(instr_path)+11] = '\0';
            remove(any_str);
            instr_blks[pick].qa_sets[i].names[0] = '\0';
            strg_blnk_pad(instr_blks[pick].qa_sets[i].names, 10);
         } /* Get lesson file */
      } /* Delete all lessons */

      if (reply == 's' || reply == 'S')
      { /* Delete selected lessons */
         valid = TRUE;
         while (valid)
         { /* Delete selection */
            move(23, 0);
```

```
                clrtoeol();
                mvaddstr(23, 0, "Enter index of lesson to be deleted:");
                getstr_echo(any_str);
                move(23, 37);
                clrtoeol();
                refresh();
                if (any_str[0] == 'q' || any_str[0] == 'Q')
                { /* Exiting */
                   valid = FALSE;
                   continue;
                } /* Exiting */
                sscanf(any_str, "%d", &reply);
                strcpy(filestr, instr_path);
                strcat(filestr, "/");
                strncat(filestr, instr_blks[pick].qa_sets[reply-1].names,
10);
                filestr[strlen(instr_path)+11] = '\0';
                remove(filestr);
                for (i=reply-1; i<=instr_blks[pick].no_qa_sets-2; i++)
                { /* Compress lesson list */
                   strncpy(instr_blks[pick].qa_sets[i].names,
                      instr_blks[pick].qa_sets[i+1].names, 10);
                } /* Compress lesson list */
                instr_blks[pick].
                   qa_sets[instr_blks[pick].no_qa_sets-1].names[0] = '\0';
                strg_blnk_pad(instr_blks[pick].
                   qa_sets[instr_blks[pick].no_qa_sets-1].names, 10);
                instr_blk_cnt--;
                instr_blk_vis(pick);
             } /* Delete selection */
          } /* Delete selected lessons */
       } /* Determine complete or selective deletion */
       for (i=pick; i<instr_blk_cnt-1; i++)
       { /* Delete selected instruction block entry */
          strncpy(instr_blks[i].title, instr_blks[i+1].title, 80);
          instr_blks[i].no_qa_sets = instr_blks[i+1].no_qa_sets;
          for (j=0; j<50; j++)
            strncpy(instr_blks[i].qa_sets[j].names,
               instr_blks[i+1].qa_sets[j].names, 10);
       } /* Delete selected instruction block entry */
       lesson_blk_rec_init(instr_blk_cnt-1);
       for (i=0; i<instr_blk_cnt; i++)
          lesson_blk_io('W', i);
       instr_blk_cnt--;

    } /* Deleting an instruction block */

    else if (select == '3')
    { /* Modifying an instruction block */
       pick = lesson_list(instr_blk_cnt);
       valid = TRUE;
       while (valid)
       { /* Modify selected fields */
          instr_blk_vis(pick);
```

```
mvaddstr(23, 0, "Modifying (t)itle or (l)esson:");
reply = tolower(getch());

if (reply == 'q')
{ /* Modification completed */
   valid = FALSE;
} /* Modification completed */

else if (reply == 't' || reply == 'T')
{ /* Modifying title */
   mvaddstr(22, 0, "Enter title:");
   clrtobot();
   move(23,0);
   getstr_echo(any_str);
   strg_blnk_pad(any_str, 80);
   strncpy(instr_blks[pick].title, any_str, 80);
   lesson_blk_io('W', pick);
} /* Modifying title */

else if (reply == 'l' || reply == 'L')
{ /* Modifying a lesson name */
   move(22, 0);
   clrtobot();
   mvaddstr(22, 0, "Enter index of lesson to be changed: ");
   getstr_echo(any_str);
   sscanf(any_str, "%d", &reply);
   reply--;
   mvaddstr(23, 0, "Change: (d)elete, (m)odify, (i)nsert:");
   reply1 = tolower(getch());

   if (reply1 == 'd')
   { /* Delete lesson from list */
      for (i=reply; i<instr_blks[pick].no_qa_sets-1; i++)
         strncpy(instr_blks[pick].qa_sets[i].names,
            instr_blks[pick].qa_sets[i+1].names, 10);
      instr_blks[pick].qa_sets[instr_blks[pick].no_qa_sets-1].
         names[0] = '\0';
      strg_blnk_pad(instr_blks[pick].
         qa_sets[instr_blks[pick].no_qa_sets-1].names, 10);
      instr_blks[pick].no_qa_sets--;
      lesson_blk_io('W', pick);
   } /* Delete lesson from list */

   else if (reply1 == 'm' || reply1 == 'M')
   { /* Modify lesson name */
      move(23, 0);
      clrtoeol();
      addstr("Enter lesson name: ");
      getstr_echo(any_str);
      strg_blnk_pad(any_str, 10);
      strncpy(instr_blks[pick].qa_sets[reply].names, any_str, 10);
      lesson_blk_io('W', pick);
   } /* Modify lesson name */
```

```
            else if (reply1 == 'i' || reply1 == 'I')
            { /* Insert a lesson name */
               for (i=instr_blks[pick].no_qa_sets-1; i>=reply; i--)
                  strncpy(instr_blks[pick].qa_sets[i+1].names,
                     instr_blks[pick].qa_sets[i].names, 10);
               move(23,0);
               clrtoeol();
               addstr("Enter lesson name: ");
            getstr_echo(any_str);
               strg_blnk_pad(any_str, 10);
               strncpy(instr_blks[pick].qa_sets[reply].names, any_str, 10);
               instr_blks[pick].no_qa_sets++;
               lesson_blk_io('W', pick);
            } /* Insert a lesson name */

            else
            { /* No change */
               continue;
            } /* No change */
         } /* Modifying a lesson name */

         else
         { /* No change */
            continue;
         } /* No change */
      } /* Modify selected fields */

   } /* Modifying an instruction block */

   else if (select == '4')
   { /* Review an instuction block */
      instr_review = lesson_list(instr_blk_cnt);
      *rtn_state = 1;
      return;
   } /* Review an instuction block */

   else
   { /* Option not yet available */
      cntr_ln(y_mid, "Option is not available");
      refresh();
      *rtn_state = 1;
   } /* Option not yet available */

   return;

} /* Instructor */
```

```
NAME:  INSTR_RU.C

#include <curses.h>
#include <string.h>

#include "itsdef.h"
```

```
void lesson_blk_rec_init(int ndx)
( /* Initialize a record in lesson block file */
int i,j;

   for (i=0; i<80; i++)   /* Blank fill title area */
      instr_blks[ndx].title[i] = ' ';

   instr_blks[ndx].no_qa_sets = 0;   /* Zero number of Q&A sets */

   for (i=0; i<50; i++)
   ( /* Blank fill each Q&A set name */
      for (j=0; j<10; j++)
         instr_blks[ndx].qa_sets[i].names[j] = ' ';
   ) /* Blank fill each Q&A set name */
   return;

) /* Initialize a record in lesson block file */
```

```
int lesson_list(max_cnt)
{ /* Display lesson block titles */

/* Routine assumes that the area consisting of lines 2-22 is clear and will

return the values of:
                    (value) = entry number of selection
                         -1 = display terminated without selection
*/
extern int x_mid;
extern int instr_blk_cnt;

int loop_cntl;
int beg_ent, end_ent;
int dsp_ln, cur_ln;
int cur_ent;
int i;
int reply;

char str_buf[81];

   clear();
   mvprintw(0, x_mid-21, "The following %d instruction blocks exist:",
      instr_blk_cnt);
   mvprintw(23, 0,
      "Use cursor to position, 'Enter' to select, or 'Q' to quit");

   loop_cntl = TRUE;
   beg_ent = 0;
   if (max_cnt < 9)
      end_ent = max_cnt-1;
   else
      end_ent = 9;
   cur_ln = 2;

   while (loop_cntl)
   { /* Prepare and display list */
      dsp_ln = 2;
      for (i=beg_ent; i<=end_ent; i++)
      { /* Present list */
         strncpy(str_buf, instr_blks[i].title, 80);
         str_buf[80] = '\0';
         if (cur_ln == dsp_ln) attrset(A_REVERSE);
         mvaddstr(dsp_ln, 0, str_buf);
         if (cur_ln == dsp_ln) attrset(0);
         dsp_ln++;
      } /* Present list */
      move(23,60);

      reply = getch();
      cur_ent = beg_ent + cur_ln - 2;
      switch (reply)
      { /* Examine user's input */
```

```
      case KEY_UP:
         if (cur_ent == 0) break;
         cur_ln--;
         cur_ent--;
         if (cur_ent < beg_ent)
         { /* Scoll display down */
            cur_ln++;
            beg_ent--;
            end_ent--;
         } /* Scoll display down */
         break;

      case KEY_DOWN:
         if (cur_ent == (max_cnt-1)) break;
         cur_ln++;
         cur_ent++;
         if (cur_ent > end_ent)
         { /* Scroll display up */
            cur_ln--;
            beg_ent++;
            end_ent++;
         } /* Scroll display up */
         break;

      case '\r':
      case 0x157:
         loop_cntl = FALSE;
         break;

      case 'q':
      case 'Q':
         loop_cntl = FALSE;
         cur_ent = -1;
         break;

      default:
         break;
      } /* Examine user's input */
   } /* Prepare and display list */

   return cur_ent;

} /* Display lesson block titles */
```

```
void lesson_blk_chk()
{ /* Display a selected record from lesson.blk */
int view;
int ent_no;
int i,j;
int reply;

char txt_str[81];

struct
{
   char names[11];
} lessons[5];

   view = TRUE;
   while (view)
   { /* View an instruction block record */
      clear();
      addstr("Enter index of entry to be viewed: ");
      echo();
      getstr(txt_str);
      noecho();
      sscanf(txt_str, "%d", &ent_no);
      if (ent_no == -2)
      { /* Exit */
         its_stop();
      } /* Exit */
      if (ent_no < 0)
      { /* End viewing of records */
         view = FALSE;
         break;
      } /* End viewing of records */

      clear();
      strncpy(txt_str, instr_blks[ent_no].title,80);
      txt_str[80] = '\0';
      printw("Title:\n%s\n", txt_str);
      printw("   Q&A set count = %2d\n", instr_blks[ent_no].no_qa_sets);

      for (i=0; i<10; i++)
      { /* Display lesson files */
         for (j=0; j<5; j++)
         {
            strncpy(lessons[j].names,
               instr_blks[ent_no].qa_sets[i+(j*10)].names,10);
            lessons[j].names[10] = '\0';
         }
         printw("%2d)%s %2d)%s %2d)%s %2d)%s %2d)%s\n", i,lessons[0].names,
            i+10,lessons[1].names, i+20,lessons[2].names,
            i+30,lessons[3].names, i+40,lessons[4].names);
      } /* Display lesson files */
      mvprintw(23,0,"Press any key to continue");
      reply = getch();
```

```
    } /* View an instruction block record */
    return;

} /* Display a selected record from lesson.blk */
```

```
void instr_blk_vis(int ent_no)
{ /* Display entry from 'instruct.blk' */
extern struct curricula instr_blks[];

int i, j;
char txt_str[81];

struct /* Lesson filename strings */
{
   char names[11];
} lesson[5];

   clear();
   strncpy(txt_str, instr_blks[ent_no].title, 80);
   txt_str[80] = '\0';
   printw("Title:\n%s\n", txt_str);

   for (i=0; i<10; i++)
   { /* Display lesson files */
      for (j=0; j<5; j++)
      { /* Make filename strings */
         strncpy(lesson[j].names,
            instr_blks[ent_no].qa_sets[i+(j*10)].names, 10);
         lesson[j].names[10] = '\0';
      } /* Make filename strings */
      printw("%2d)%s %2d)%s %2d)%s %2d)%s %2d)%s\n\n", i+1,lesson[0].names,
         i+11,lesson[1].names, i+21,lesson[2].names, i+31,lesson[3].names,
         i+41,lesson[4].names);
   } /* Display lesson files */
   refresh();
   return;

} /* Display entry from 'instruct.blk' */
```

```
void make_pos(int ndx, int *y_pos, int *x_pos)
{ /* Convert ndx to screen coordinates */
int quo, rem;

   quo = ndx/10;
   rem = ndx - (quo*10);
   *y_pos = (rem*2) + 3;
   *x_pos = (quo*14) + 3;
   return;

} /* Convert ndx to screen coordinates */
```

NAME: STUDENT.C

```
/*****************************************************************************
   For the following, the numerous switches are presented in numerical
   order, but the use of pagination is done to infer a logical order.
   This logical ordering" is as follows:

     a.   0-79:  Function select switches

     b.   80-87:     Feature & Vector switches          Required Switches
          88-105:    Category Select switches          for WD Console
          142-159:   Category Select switches          Checkout

     c.   106-141:  Optional Category Select switches

     d.   160-184:  Display Panel switches
*****************************************************************************/

#include <curses.h>
#include <string.h>
#include "itsdef.h"

void student(int *stdt_status)
{ /* Student */
extern void get_max_min();
extern int user_type;
extern char instr_path[];
extern char stdt_path[];
extern FILE *lesson_fp;
extern instr_blk_cnt;
extern int y_mid;
extern int x_mid;
extern struct stdt_db pupil;
extern FILE *present_fp;
extern struct lesson_file_entry lesson_map[];
extern int stdt_acc_score;

int i;
int file_status;
int valid, next_lesson;
int reply;
int map_cnt;
int map_ndx;
int scan_it;
int prev_text;

long int file_offset;

char name_str[27], ssan_str[10];
char any_str[81];
char any_str1[81];
char *srch_char;
```

```
   } /* Error opening file */
   work_msg();
   instr_blk_cnt = 0;
   for (i=0; i<50; i++)
   { /* Load 'instruct.blk' into memory */
      lesson_blk_io('R', i);
      if (instr_blks[i].no_qa_sets != 0)
         instr_blk_cnt++;
   } /* Load 'instruct.blk' into memory */
   instruct_blk_open = TRUE;
} /* Establish path to instructor files */

get_path_str("Student", stdt_path);
if (strlen(stdt_path) == 0)
   return;

if (user_type == Student)
{ /* Check student's registration */
   valid = FALSE;
   while (!valid)
   { /* Validate */
      student_ident(name_str, ssan_str);
      strg_blnk_pad(name_str, 26);
      strcpy(any_str, "sdb_");
      strncat(any_str, &ssan_str[5], 4);
      file_status = chk_file(stdt_path, any_str);
      file_str(stdt_path, any_str, any_str1);
      if (file_status == 1)
      { /* Possible New Student */
         clear();
         cntr_ln(y_mid-1, "Are you a new student? [Y/N]:");
         reply = tolower(getch());
         if (reply == 'y')
         { /* Open new student file */
            valid = TRUE;
            student_fp = fopen(any_str1, "w+");

            /* Initialize student db file */
            strncpy(pupil.name, name_str, 26);
            strncpy(pupil.ssan, ssan_str, 9);
            pupil.instr_blk_ndx = -1;
            pupil.lesson_ndx = -1;
            pupil.text_blk_ndx = 1;
            pupil.know_phase_ndx = 1;
            student_blk_io('W', 0);
            for (i=0; i<5; i++)
            { /* Initialize knowledge phase data */
               pupil.know_phase[i].max_val = 0;
               pupil.know_phase[i].min_val = 0;
               pupil.know_phase[i].act_val = 0;
               pupil.know_phase[i].spare_val = 0;
               student_blk_io('W',i+1);
            } /* Initialize knowledge phase data */
         } /* Open new student file */
```

```
            else
            { /* Error */
               clear();
               cntr_ln(y_mid,"Please validate name and SSAN again");
               cntr_ln(y_mid+1, "Enter any key to continue");
               getch();
            } /* Error */
         } /* Possible New Student */
         else
         { /* Existing Student */
            student_fp = fopen(any_str1, "r+");
            student_blk_io('R', 0);   /* Read header */
            for (i=1; i<=5; i++)
               student_blk_io('R', i); /* Read knowledge phase data */
            if (strncmp(pupil.name, name_str, 26) != 0 ||
               strncmp(pupil.ssan, ssan_str, 9) != 0)
            { /* Name or SSAN mismatch */
               clear();
               cntr_ln(y_mid,
                  "Name or SSAN mismatch with original registration");
               cntr_ln(y_mid+1, "Please validate name and SSAN again");
               cntr_ln(y_mid+2, "Press any key to continue");
               getch();
            } /* Name or SSAN mismatch */
            else
               valid = TRUE;
         } /* Existing Student */
      } /* Validate */
   } /* Check student's registration */

   if (user_type == Instructor)
   { /* Reviewing an instruction block */
      pupil.instr_blk_ndx = instr_review;
      pupil.lesson_ndx = 0;
   } /* Reviewing an instruction block */

   valid = TRUE;
   present_fp = NULL;
   stdt_acc_score = 0;
   file_offset = 0;
   prev_text = pupil.text_blk_ndx;
   while (valid)
   { /* Presenting a lesson */
      if (present_fp == NULL)
      { /* Open lesson file */
         if (pupil.instr_blk_ndx == -1)
            strcpy(any_str, "welcome");   /* New Student */
         else
         { /* Get next lesson */
            strncpy(any_str,

instr_blks[pupil.instr_blk_ndx].qa_sets[pupil.lesson_ndx].names,
               10);
            any_str[10] = '\0';
```

```
} /* Get next lesson */
file_status = chk_file(instr_path, any_str);
if (file_status == 1)
{ /* File doesn't exist */
   valid = FALSE;
   continue;
} /* File doesn't exist */
file_str(instr_path, any_str, any_str1);
present_fp = fopen(any_str1, "r");

/* Build map of lesson file */
file_offset = 0;
map_cnt = 0;
next_lesson = TRUE;
fseek(present_fp, file_offset, SEEK_SET);
while (fgets(any_str, 81, present_fp) != NULL)
{ /* Build map */
   if (next_lesson)
   { /* Build map entry */
      lesson_map[map_cnt].file_pos = file_offset;
      file_offset += strlen(any_str);
      sscanf(any_str, "%d", &lesson_map[map_cnt].num_id);
      srch_char = strchr(any_str, ' ');
      if (strncmp(&any_str[srch_char-any_str+1],
         "text", 4) == 0)
         lesson_map[map_cnt].text_type = 1;
      else if (strncmp(&any_str[srch_char-any_str+1],
         "multiple choice", 15) == 0)
         lesson_map[map_cnt].text_type = 2;
      else if (strncmp(&any_str[srch_char-any_str+1],
         "true/false", 10) == 0)
         lesson_map[map_cnt].text_type = 3;
      else if (strncmp(&any_str[srch_char-any_str+1],
         "yes/no", 6) == 0)
         lesson_map[map_cnt].text_type = 4;
      else if (strncmp(&any_str[srch_char-any_str+1],
         "score", 5) == 0)
         lesson_map[map_cnt].text_type = 5;
      else if (strncmp(&any_str[srch_char-any_str+1],
         "instruct/lesson", 15) == 0)
         lesson_map[map_cnt].text_type = 6;
      else if (strncmp(&any_str[srch_char-any_str+1],
         "noscore", 7) == 0)
         lesson_map[map_cnt].text_type = 7;
      else
      { /* Problem with file format */
         clear();
         any_str[strlen(any_str)-1] = '\0';
         mvprintw(y_mid, 0, "%s is not a valid text type",
            &any_str[srch_char-any_str+1]);
         refresh();
         return;
      } /* Problem with file format */
```

```
/* Get next identifiers of follow-on texts */
fseek(present_fp, file_offset, SEEK_SET);
fgets(any_str, 81, present_fp);
file_offset += strlen(any_str);
srch_char = any_str;
for (i=0; i<5; i++)
{ /* Get each follow-on */
   sscanf(&any_str[srch_char-any_str], "%d",
      &lesson_map[map_cnt].know_level[i]);
   if (i < 4)
   { /* Search for blank and advance */
      srch_char = strchr(&any_str[srch_char-any_str], ' ');
      srch_char++;
   } /* Search for blank and advance */
} /* Get each follow-on */

/* Indicate no previous display */
lesson_map[map_cnt].prev_num_id = -1;

/* Blank out student repsonse */
lesson_map[map_cnt].stdt_ans = ' ';

/* Get answers and values for:                              */
/*     2) multiple choice                                   */
/*     3) true/false                                        */
/*     4) yes/no                                            */
/*     5) scoring function                                  */
/*     6) instruct/lesson branch                            */
/*     7) No scoring function                               */

if (lesson_map[map_cnt].text_type >= 2 &&
   lesson_map[map_cnt].text_type <= 7)
{ /* Other text types */
   fseek(present_fp, file_offset, SEEK_SET);
   fgets(any_str, 81, present_fp);
   file_offset += strlen(any_str);
   srch_char = any_str;
   map_ndx = 0;
   scan_it = TRUE;
   while (scan_it)
   { /* Get answers and associated values */
      srch_char = strchr(&any_str[srch_char-any_str], ')');
      if (srch_char != NULL)
      { /* Store possible answer and its value */
         lesson_map[map_cnt].mc_ans[map_ndx].ans_desig =
            any_str[srch_char-any_str-1];   /* Answer */
         sscanf(&any_str[srch_char-any_str+1], "%d",
            &lesson_map[map_cnt].mc_ans[map_ndx].ans_val);
         srch_char++;
         map_ndx++;
      } /* Store possible answer and its value */
      else
         scan_it = FALSE;
   } /* Get answers and associated values */
```

```
            lesson_map[map_cnt].mc_ans_cnt = map_ndx;
         } /* Other text types */

         next_lesson = FALSE;
         map_cnt++;
      } /* Build map entry */

      else
      { /* Skip this line */
         file_offset += strlen(any_str);
         if (any_str[0] == '\f')
            next_lesson = TRUE;
      } /* Skip this line */

      fseek(present_fp, file_offset, SEEK_SET);
   } /* Build map */
} /* Open lesson file */

if (pupil.text_blk_ndx == -1)
{ /* End of current lesson */
   clear();
   cntr_ln(y_mid, "End of lesson");
   getch();
   fclose(present_fp);
   student_blk_io('W', 0);
   for (i=0; i<5; i++)
      student_blk_io('W', i+1);
   valid = FALSE;
   *stdt_status = 1;
   break;
} /* End of current lesson */

file_offset = -1;
for (i=0; i<map_cnt; i++)
{ /* Search for selected text */
   if (pupil.text_blk_ndx == lesson_map[i].num_id)
   { /* Match found */
      file_offset = lesson_map[i].file_pos;
      if (lesson_map[i].prev_num_id == -1)
         lesson_map[i].prev_num_id = prev_text;
      map_ndx = i;
      break;
   } /* Match found */
} /* Search for selected text */

if (file_offset < 0)
{ /* Text does not exist */
   clear();
   mvprintw(y_mid, x_mid-23,
      "Text %3d does not exist for block %2d, lesson %2d",
      pupil.text_blk_ndx, pupil.instr_blk_ndx, pupil.lesson_ndx);
   refresh();
   its_stop();
} /* Text does not exist */
```

```
fseek(present_fp, lesson_map[map_ndx].file_pos, SEEK_SET);
switch (lesson_map[map_ndx].text_type)
{ /* Display text types */
case 1:
case 2:
case 3:
case 4:
   reply = prsnt_txt(map_ndx);
   break;

case 5:
case 7:
   reply = score_txt(map_ndx);
   break;

case 6:
   reply = lesson_txt(map_ndx);
   break;

default:
   clear();
   cntr_ln(y_mid, "This is impossible and should not have happened");
   refresh();
   its_stop();
} /* Display text types */

if (reply == 1)
   valid = FALSE;   /* Terminate lesson presentation */
else if (reply == 2)
{ /* Get next text block */
   if (lesson_map[map_ndx].text_type <= 4)
      prev_text = pupil.text_blk_ndx;
   if (lesson_map[map_ndx].text_type != 7)
         pupil.text_blk_ndx =
            lesson_map[map_ndx].know_level[pupil.know_phase_ndx-1];
} /* Get next text block */
else if (reply == 3)
{ /* Get previous text */
   if (pupil.text_blk_ndx != lesson_map[map_ndx].prev_num_id)
      pupil.text_blk_ndx = lesson_map[map_ndx].prev_num_id;
   for (i=0; i<map_cnt; i++)
   { /* Get index */
      if (pupil.text_blk_ndx == lesson_map[i].num_id)
      { /* Match */
         map_ndx = i;
         break;
      } /* Match */
   } /* Get index */
   if (lesson_map[map_ndx].text_type != 1)
      get_max_min(map_ndx, '-');
} /* Get previous text */
else if (reply == 4)
{ /* Get next instruction block/lesson */
```

```
      } /* Get next instruction block/lesson */
      else
      { /* Oops ! */
         clear();
         cntr_ln(y_mid, "This shouldn't have happened either");
         refresh();
         its_stop();
      } /* Oops ! */

   } /* Presenting a lesson */

   return;
} /* Student */
```

```
NAME:  STDT_RUT.C

#include <curses.h>
#include <string.h>
#include <ctype.h>

#include "itsdef.h"
```

```
void student_ident(char *name_str, char *id_str)
{ /* Get student's name and identifier */
extern int x_mid;
extern int y_mid;
extern void get_ssan();

int valid, ack;

   clear();
   cntr_ln(y_mid-2,"Enter name and SSAN:\n");
   mvaddstr(y_mid, x_mid-11, "Name:");

   valid = FALSE;
   while (!valid)
   { /* Get name */
      move(y_mid, x_mid-5);
      getstr_echo(name_str);
      cntr_ln(y_mid+2, "Is name spelled correctly? [Y/N]");
      ack = tolower(getch());
      if (ack == 'y')
         valid = TRUE;   /* Valid Name */
      move(y_mid+2, 0);
      clrtoeol();
   } /* Get name */

   mvaddstr(y_mid+1, x_mid-11, "SSAN:");
   valid = FALSE;
   while (!valid)
   { /* Get Id */
      mvaddstr(y_mid+1, x_mid-5, "xxx-xx-xxxx");
      move(y_mid+1, x_mid-5);
      refresh();
      get_ssan(id_str);
      cntr_ln(y_mid+3, "Is SSAN correct? [Y/N]");
      ack = tolower(getch());
      if (ack == 'y')
         valid = TRUE;
      move(y_mid+3, 0);
      clrtoeol();
   } /* Get Id */
   return;

} /* Get student's name and identifier */
```

```
void get_ssan(char *a_strng)
{ /* Get a SSAN string */

int pos;
int not_digit;
int x_coord, y_coord;

   getyx(stdscr, y_coord, x_coord);
   not_digit = FALSE;
   pos = 0;
   while (pos < 9)
   { /* Get digits */
      *(a_strng) = getch();
      if (not_digit)
      { /* Clear error msg */
         move(y_coord+2,0);
         clrtoeol();
         move(y_coord, x_coord);
         refresh();
         not_digit = FALSE;
      } /* Clear error msg */
      if (!isdigit(*(a_strng)))
      { /* Must be a digit */
         cntr_ln(y_coord+2, "Must be a digit");
         move(y_coord, x_coord);
         refresh();
         not_digit = TRUE;
      } /* Must be a digit */
      else
      { /* Next digit */
         addch(*a_strng);
         a_strng++;
         pos++;
         if (pos == 3 || pos == 5)
            x_coord++;
         x_coord++;
         move(y_coord, x_coord);
      } /* Next digit */
   } /* Get digits */
   noecho();
   return;

} /* Get a SSAN string */
```

```
void student_blk_io(char io_type, int rec_ndx)
{ /* Provide I/O for student db file */
extern FILE *student_fp;
extern struct stdt_db pupil;

char stdt_rec[81];

   if (tolower(io_type) == 'w')
   { /* Write a record to student db */
      if (rec_ndx == 0)
      { /* Header record */
         fseek(student_fp, 0, SEEK_SET);
         sprintf(stdt_rec, "%9.9s¦%-26.26s¦%02d¦%02d¦%02d¦%02d\n",
            pupil.ssan, pupil.name, pupil.instr_blk_ndx, pupil.lesson_ndx,
            pupil.text_blk_ndx, pupil.know_phase_ndx);
         fputs(stdt_rec, student_fp);
      } /* Header record */
      else
      { /* Knowledge phase record */
         fseek(student_fp, ((rec_ndx-1)*20)+49, SEEK_SET);
         sprintf(stdt_rec,"%04d¦%04d¦%04d¦%04d\n",
            pupil.know_phase[rec_ndx-1].max_val,
            pupil.know_phase[rec_ndx-1].min_val,
            pupil.know_phase[rec_ndx-1].act_val,
            pupil.know_phase[rec_ndx-1].spare_val);
         fputs(stdt_rec, student_fp);
      } /* Knowledge phase record */
   } /* Write a record to student db */

   else if (tolower(io_type) == 'r')
   { /* Read a record from student db */
      if (rec_ndx == 0)
      { /* Header record */
         fseek(student_fp, 0, SEEK_SET);
         fgets(stdt_rec, 49, student_fp);
         strncpy(pupil.ssan, stdt_rec, 9);
         strncpy(pupil.name, &stdt_rec[10], 26);
         sscanf(&stdt_rec[37], "%2d", &pupil.instr_blk_ndx);
         sscanf(&stdt_rec[40], "%2d", &pupil.lesson_ndx);
         sscanf(&stdt_rec[43], "%2d", &pupil.text_blk_ndx);
         sscanf(&stdt_rec[46], "%2d", &pupil.know_phase_ndx);
      } /* Header record */
      else
      { /* Knowledge phase record */
         fseek(student_fp, ((rec_ndx-1)*20)+49, SEEK_SET);
         fgets(stdt_rec, 20, student_fp);
         sscanf(stdt_rec, "%4d", &pupil.know_phase[rec_ndx-1].max_val);
         sscanf(&stdt_rec[4], "%4d", &pupil.know_phase[rec_ndx-1].min_val);
         sscanf(&stdt_rec[8], "%4d", &pupil.know_phase[rec_ndx-1].act_val);
         sscanf(&stdt_rec[12], "%4d",
&pupil.know_phase[rec_ndx-1].spare_val);
      } /* Knowledge phase record */
   } /* Read a record from student db */
```

```
    else
    { /* Error in I/O specification */
       clear();
       addstr("student_blk_io error: I/O type specification");
       refresh();
       its_stop();
    } /* Error in I/O specification */
    return;

} /* Provide I/O for student db file */
```

```
void read_prsnt_txt(int map, int *file_offset, int *disp_map, int
*disp_ndx,
   char *disp_str)
{ /* Read and map a line of text */
extern FILE *prsent_fp;

   fseek(present_fp, *file_offset, SEEK_SET);
   fgets(disp_str, 81, present_fp);
   if (map == -1)
   { /* Map the text block */
      disp_map[*disp_ndx] = *file_offset;
      (*disp_ndx)++;
   } /* Map the text block */
   *file_offset += strlen(disp_str);
   return;

} /* Read and map a line of text */
```

```
int prsnt_txt(int map_ndx)
{ /* Present text to user */
extern struct lesson_file_entry lesson_map[];
extern FILE *present_fp;
extern int stdt_acc_score;
extern void get_max_min();
extern void reply_pos();
extern int first_ques;

int disp_ndx;
int line_cnt;
int i;
int beg_ln, end_ln;
int display_it;
int reply;
int paint_it;
int match_found;
int key_state;

long int file_offset;
long int disp_map[100];

char disp_str[81];

   /* Skip the first and second line */
   disp_ndx = 0;
   file_offset = lesson_map[map_ndx].file_pos;
   read_prsnt_txt(0, &file_offset, disp_map, &disp_ndx, disp_str);
   read_prsnt_txt(0, &file_offset, disp_map, &disp_ndx, disp_str);

   /* Skip next line if multiple choice, true/false, or scoring */
   if (lesson_map[map_ndx].text_type != 1)
      read_prsnt_txt(0, &file_offset, disp_map, &disp_ndx, disp_str);

   /* Get line count */
   read_prsnt_txt(0, &file_offset, disp_map, &disp_ndx, disp_str);
   sscanf(disp_str, "%d", &line_cnt);

   /* Create line display map */
   for (i=0; i<line_cnt; i++)
      read_prsnt_txt(-1, &file_offset, disp_map, &disp_ndx, disp_str);

   /* Present first page */
   beg_ln = 0;
   if (line_cnt <= LINES-2)
      end_ln = line_cnt - 1;
   else
      end_ln = LINES - 2;

   if (lesson_map[map_ndx].text_type > 1 && first_ques == -1)
      first_ques = map_ndx;

   if (lesson_map[map_ndx].text_type > 1 && lesson_map[map_ndx].stdt_ans !=
```

```
' ')
   { /* Backout existing value */
      for (i=0; i<lesson_map[map_ndx].mc_ans_cnt; i++)
      { /* Search for match */
         if (lesson_map[map_ndx].stdt_ans ==
            lesson_map[map_ndx].mc_ans[i].ans_desig)
         { /* Matching answer */
            if ((stdt_acc_score - lesson_map[map_ndx].mc_ans[i].ans_val) >=
0)
            { /* Adjust score */
               stdt_acc_score -=
                  lesson_map[map_ndx].mc_ans[i].ans_val;
               if (stdt_acc_score == 0 && first_ques != map_ndx)
                  stdt_acc_score +=
                     lesson_map[map_ndx].mc_ans[i].ans_val;
               break;
            } /* Adjust score */
         } /* Matching answer */
      } /* Search for match */
   } /* Backout existing value */

   if (lesson_map[map_ndx].text_type != 1)
      get_max_min(map_ndx, '+');

   paint_it = TRUE;
   display_it = TRUE;
   while (display_it)
   { /* Display a text block */
      if (paint_it)
      { /* Paint screen */
         clear();
         file_offset = disp_map[beg_ln];
         for (i=beg_ln; i<=end_ln; i++)
         { /* Display text */
            read_prsnt_txt(1, &file_offset, disp_map, &disp_ndx, disp_str);
            mvprintw(i-beg_ln, 0, "%s", disp_str);
         } /* Display text */
         if (end_ln < line_cnt-1)
         { /* Display "more" message */
            attrset(A_BLINK);
            cntr_ln(LINES-1, "More");
            attrset(0);
         } /* Display "more" message */
         else
         { /* Clear "more" message  and prompt for answer, if necessary */
            move(LINES-1,0);
            clrtoeol();
            if (lesson_map[map_ndx].text_type != 1)
            { /* Possible response */
               if (lesson_map[map_ndx].text_type == 2)
                  mvaddstr(LINES-1, 0, "Selection: ");   /* Multiple Choice
*/
               else if (lesson_map[map_ndx].text_type == 3)
                  mvaddstr(LINES-1, 0, "(t)rue/(f)alse: ");   /* True/False
```

```
*/
            else
               mvaddstr(LINES-1, 0, "(y)es/(n)o: "); /* Yes/No */
            if (lesson_map[map_ndx].stdt_ans != ' ' &&
               lesson_map[map_ndx].stdt_ans != 'x')
            { /* Display previous answer */
               addch(lesson_map[map_ndx].stdt_ans);
               reply_pos(map_ndx);
            } /* Display previous answer */
         } /* Possible response */
      } /* Clear "more" message  and prompt for answer, if necessary */
      paint_it = FALSE;
   } /* Paint screen */

   reply = tolower(getch());
   switch (reply)
   { /* Get user's reply */
   case KEY_UP:
      if (end_ln < line_cnt-1)
      { /* Move up one line */
         beg_ln++;
         if (beg_ln+LINES-2 <= line_cnt)
            end_ln = beg_ln + LINES - 2;
         else
            end_ln = line_cnt - 1;
         paint_it = TRUE;
      } /* Move up one line */
      break;

   case KEY_DOWN:
   case 0x43:
      if (beg_ln > 0)
      { /* Move down one line */
         beg_ln--;
         if (beg_ln+LINES < line_cnt)
            end_ln = beg_ln+ LINES - 2;
         else
            end_ln = line_cnt -1;
         paint_it = TRUE;
      } /* Move down one line */
      break;

   case 'q':   /* Quit */
      key_state = 1;
      display_it = FALSE;
      break;

   case 0x02: /* Ctrl-B: Page backward */
      if (beg_ln > 0)
      { /* Paging backwards */
         if (beg_ln-LINES+2 < 0)
            beg_ln = 0;
         else
            beg_ln = beg_ln - LINES + 2;
```

```
      if (beg_ln+LINES-2 > line_cnt)
         end_ln = line_cnt - 1;
      else
         end_ln = beg_ln + LINES - 2;
      paint_it = TRUE;
   } /* Paging backwards */
   break;

case 0x06: /* Ctrl-F: Page forward */
   if (end_ln < line_cnt - 1)
   { /* Paging forward */
      if (end_ln+LINES-2 > line_cnt)
         end_ln = line_cnt - 1;
      else
         end_ln = end_ln + LINES - 2;
      if (end_ln-LINES+2 < 0)
         beg_ln = 0;
      else
         beg_ln = end_ln - LINES + 2;
      paint_it = TRUE;
   } /* Paging forward */
   break;

case 0x0e:  /* Ctrl-N: Next text */
case '\r':  /* Carriage return from VT100 */
case 0x157: /* Carriage return from SG */
   if ((lesson_map[map_ndx].text_type == 1) &&
      (reply == '\r' || reply == 0x157) &&
      (end_ln < line_cnt-1))
      break;
   if (lesson_map[map_ndx].text_type > 1)
   { /* Score result */
      for (i=0; i<lesson_map[map_ndx].mc_ans_cnt; i++)
      { /* Search for match */
         if (lesson_map[map_ndx].stdt_ans ==
            lesson_map[map_ndx].mc_ans[i].ans_desig)
         { /* Accumulate value */
            stdt_acc_score +=
               lesson_map[map_ndx].mc_ans[i].ans_val;
            break;
         } /* Accumulate value */
      } /* Search for match */
   } /* Score result */
   key_state = 2;
   display_it = FALSE;
   break;

case 0x10: /* Ctrl-P: Previous text */
   if (lesson_map[map_ndx].text_type != 1)
      get_max_min(map_ndx, '-');
   key_state = 3;
   display_it = FALSE;
   break;
```

```
      default:
         if ((lesson_map[map_ndx].text_type == 1) || (end_ln < line_cnt-1))
            break;
         reply_pos(map_ndx);
         clrtoeol();
         addch(reply);
         reply_pos(map_ndx);
         match_found = FALSE;
         for (i=0; i<lesson_map[map_ndx].mc_ans_cnt; i++)
         { /* Determine if valid response */
            if (lesson_map[map_ndx].mc_ans[i].ans_desig == reply)
            { /* Match found */
               match_found = TRUE;
               break;
             } /* Match found */
         } /* Determine if valid response */
         if (! match_found)
         { /* In valid response */
            printw("%c - invalid repsonse", reply);
            reply_pos(map_ndx);
         } /* In valid response */
         else
         { /* Valid response */
            lesson_map[map_ndx].stdt_ans = reply;
         } /* Valid response */
         break;
      } /* Get user's reply */
   } /* Display a text block */

   return key_state;
} /* Present text to user */
```

```
int score_txt(int map_ndx)
{ /* Assess student's score */
extern struct lesson_file_entry lesson_map[];
extern int stdt_acc_score;
extern struct stdt_db pupil;
extern int first_ques;

int i;
int reply;

   if (lesson_map[map_ndx].text_type == 5)
   { /* Verify satisfaction with previous answers */
      clear();
      cntr_ln(y_mid, "Are you satisfied with your previous answers? [Y/N]:
");
      reply = tolower(getch());
      if (reply != 'y')
      { /* Reviewing answers */
         return 3;
      } /* Reviewing answers */
   } /* Verify satisfaction with previous answers */

   if (lesson_map[map_ndx].text_type == 5)
   {
      pupil.know_phase[pupil.know_phase_ndx-1].act_val += stdt_acc_score;
      first_ques = -1;
   }
   for(i=0; i<lesson_map[map_ndx].mc_ans_cnt; i++)
   { /* Search of interval */
      if (stdt_acc_score <= lesson_map[map_ndx].mc_ans[i].ans_val)
      { /* Interval established */
         if (pupil.know_phase_ndx != i+1 && lesson_map[map_ndx].text_type
== 5)
         { /* Changing knowledge level */
            pupil.know_phase[i].max_val = 0;
            pupil.know_phase[i].min_val = 0;
            pupil.know_phase[i].act_val = 0;
            pupil.know_phase[i].spare_val = 0;
         } /* Changing knowledge level */
         if (lesson_map[map_ndx].text_type == 5)
            pupil.know_phase_ndx = i + 1;
         else
            pupil.text_blk_ndx = lesson_map[map_ndx].know_level[i];
         break;
      } /* Interval established */
   } /* Search of interval */
   if (lesson_map[map_ndx].text_type != 7)
      stdt_acc_score = 0;

   return 2;

} /* Assess student's score */
```

```
int lesson_txt(int map_ndx)
( /* Change lesson or instruction block */
extern FILE *present_fp;
extern struct stdt_db pupil;
extern struct lesson_file_entry lesson_map[];
extern int stdt_acc_score;

int i;
int reply;

   fclose(present_fp);
   present_fp = NULL;
   sscanf(&lesson_map[map_ndx].mc_ans[pupil.know_phase_ndx-1].ans_desig,
      "%d", &pupil.instr_blk_ndx);
   pupil.lesson_ndx =
      lesson_map[map_ndx].mc_ans[pupil.know_phase_ndx-1].ans_val;
   pupil.text_blk_ndx =
lesson_map[map_ndx].know_level[pupil.know_phase_ndx-1];
   student_blk_io('W', 0);
   for (i=0; i<5; i++)
      student_blk_io('W', i+1);
   clear();
   cntr_ln(y_mid, "End of an instruction block");
   cntr_ln(y_mid+1, "Continue [Y/N]: ");
   reply = tolower(getch());
   if (reply == 'y')
      return 4;
   else
      return 1;

) /* Change lesson or instruction block */
```

```
void get_max_min(int map_ndx, char op)
{ /* Get maximum and minimum answer values */
extern struct stdt_db pupil;
extern struct lesson_file_entry lesson_map[];

int i;
int temp_max, temp_min;

   temp_max = 0;
   temp_min = 9999;
   for (i=0; i<lesson_map[map_ndx].mc_ans_cnt; i++)
   { /* Find maximum and minimum values */
      if (lesson_map[map_ndx].mc_ans[i].ans_val > temp_max)
         temp_max = lesson_map[map_ndx].mc_ans[i].ans_val;
      if (lesson_map[map_ndx].mc_ans[i].ans_val < temp_min)
         temp_min = lesson_map[map_ndx].mc_ans[i].ans_val;
   } /* Find maximum and minimum values */
   if (op == '+')
   { /* Add max & min values */
      pupil.know_phase[pupil.know_phase_ndx-1].max_val += temp_max;
      pupil.know_phase[pupil.know_phase_ndx-1].min_val += temp_min;
   } /* Add max & min values */
   if (op == '-')
   { /* Subtract max & min values */
      pupil.know_phase[pupil.know_phase_ndx-1].max_val -= temp_max;
      pupil.know_phase[pupil.know_phase_ndx-1].min_val -= temp_min;
   } /* Subtract max & min values */
   if (op == ' ')
   { /* Display values */
      mvprintw(22,0,"high = %4d score = %4d low = %4d indx = %4d",
         pupil.know_phase[pupil.know_phase_ndx-1].max_val,
         stdt_acc_score,
         pupil.know_phase[pupil.know_phase_ndx-1].min_val,
         map_ndx);
      getch();
      move(22,0);
      clrtoeol();
      refresh();
   } /* Display values */
   return;
} /* Get maximum and minimum answer values */
```

```
void reply_pos(int map_ndx)
{ /* Position cursor for response */
extern struct lesson_file_entry lesson_map[];

   if (lesson_map[map_ndx].text_type == 2)
      move(LINES-1, 11);
   else if (lesson_map[map_ndx].text_type == 3)
      move(LINES-1, 16);
   else
      move(LINES-1, 12);

   return;
} /* Position cursor for response */
```

Appendix E

ITS User's Guide

Intelligent Tutoring System

User's Guide

You may run the ITS program using a SGI terminal even though its software is spread across a SGI/UNIX and DEC/VMS based system. Functionally, the software is used as follows:

- The presentation of the questionnaire function is accomplished using only the SGI/UNIX system.
- The presentation of the Simulation is accomplished using a combination of both the SGI/UNIX and DEC/VMS systems.
- The presentation of the evaluation software is accomplished using only the DEC/VMS system.

Each function is started separately. While having to start each function is not ideal, the modularity did provide a better software development environment with no impact to the existing Simulation software.

Questionnaire Function

To begin the Questionnaire Function, you must have the "ITS Window" on the screen. This window is sized to an 80 character by 24 line (80x24) display for the presentation of questionnaire material. Enter the following command to initiate this window:

```
wsh -n 'ITS Window' -p175,300 -s80,24
```

Enter **ITS** at the prompt within the window.

ITS prompts you as follows:

1.

```
Use cursor to select:
Instructor  Student
 then press 'Enter'
```

The desired selection is highlighted on the screen.

If you select the **Instructor** option, continue with Step 2.

If you select the **Student** option, continue with Step 13.

2. At this point, nothing on the screen changes. However, ITS expects you to enter the proper password before continuing. Entry of any other value causes the program to terminate without any indication. Once you enter the proper password, continue with Step 3.

3. ITS displays the following prompt:

Enter index of desired option:

1. Add an instruction block
2. Delete an instruction block
3. Modify an instruction block
4. Review an instruction block
5. Review a student's performance
6. Adjust a student's instruction

Selection:

Enter the desired option by specifying **1**, **2** etc.

Note: Only options 1-3 are implemented. Selections 4-6 are not implemented at this time.

Enter one of the options 1-3, continue with Step 4.

Note: If you enter any value other than 1-6, ITS displays **Invalid response**. Press the **Enter** key to acknowledge and ITS displays the following message:

Terminate ITS [Y/N]:

If you enter any value other than **Y**, ITS interprets it as a **N** response and returns to the start of this Step. If you enter **Y**, the program terminates.

4. ITS prompts you for the specification of the path to the **Instructor** directory. However, if you have already accomplished this Step (on a previous pass through the program), ITS continues with Step 5. If not, the following display appears:

Enter path to "Instructor" file directory
->

You may either specify the **Instructor** file directory or press the **Enter** key to get the default value as stipulated by **instr_path_def** in **itsdef.h**. In both cases ITS prompts you to verify the specification:

Is path correct? [Y/N/Q]:

If you enter **Q**, the program terminates.

If you enter **N**, this Step is repeated.

If you enter **Y**, continue with Step 5.

5. ITS displays titles of existing **Instruction Blocks**[1] along with the following message:

Use cursor to position, 'Enter' to select, or 'Q' to quit

If you selected option 1 in Step 3, **Add an Instruction Block**, ITS displays a reminder of existing titles. For options 2 or 3, you may choose the Instruction Block that is to be modified or deleted, respectively.

If you selected option 1 in Step 3, continue with Step 6.

If you selected option 2, **Delete an instruction block**, ITS continues with Step 9.

If you selected option 3, **Modify an instruction block**, ITS continues with Step 12.

6. ITS asks you to enter a title to the new instruction block:

Enter title (max = 80 chars):

Enter the title and continue with Step 7.

---

[1] Refer to the section *Implementation* under **Silicon Graphics Software** of this document.

7. ITS asks you if there are any lessons[2] associated with this Instruction Block:

   Any lessons in this instruction block [Y/N]:

   You may create the instruction block entry by entering a **N** and ITS continues with Step 3, or if lessons are to be added, enter **Y** and continue with Step 8.

8. ITS displays the title of the instruction block and a numbered list of empty lesson entries, followed by the prompt:

   Enter lesson name (max = 10 char):

   Enter the names of the lessons that are to comprise this instruction block. When you have finished, terminate this Step by entering a **q** to **lesson name** and ITS continues with Step 3.

9. ITS displays the title of the instruction block and a numbered list of the lessons in the block along with the following prompt:

   Do you want to delete lessons? [Y/N]:

   If you want to delete only the Instruction Block, enter **N** and ITS continues with Step 3.

   If you also want to delete lesson files, enter **Y** and continue with Step 10.

10. ITS displays the following prompt:

    Delete (a)ll or s(ome) of these lessons:

    If you want to delete **all** the lesson files listed, enter **a** and ITS continues with Step 3.

    If you want to selectively delete **some** of the lesson files, enter **s** and continue with Step 11.

---

[2] Refer to the section *Implementation* under **Silicon Graphics Software** for additional details.

11. ITS displays the following prompt:

    Enter index of lesson to be deleted:

    Enter the number that appears with the lesson name.

    Note: The numbered list is reorderd after each deletion so indices can change for each specified deletion.

    When you are finished deleting, enter q and ITS continues with Step 3.

12. ITS displays the title of the instruction block and a numbered list of the lessons in the block along with the following prompt:

    Modifying (t)itle or (l)esson:

    If you want to modify the title of the instruction block, enter a t and the prompt **Enter title** will overwrite the previous prompt and allow you to specify a new title. ITS continues with a repetition of this Step.

    If you want to modify a lesson, enter l and ITS displays the following prompt:

    Enter index of lesson to be changed:

    Enter the number associated with the lesson to be changed and ITS displays the following prompt:

    Change: (d)elete, (m)odify, (i)nsert:

    If you want to delete the selected lesson, enter d ITS continues with the repetition of this Step.

    If you want to insert or modify a lesson, enter m or i. ITS displays the prompt **Enter lesson name**. Modify or Insert the lesson name and ITS continues with a repetition of this Step.

    To terminate this Step, enter a q and ITS continues with Step 3.

13. ITS asks you to specify the path for the **Instructor** and **Student** directories. If one or both use the default values, the values for the **instructor** and **student** paths are taken from the **instr_path_def** or the **stdt_path_def** values in **itsdef.h**, respectively.

For the **instructor path**, ITS displays:

Enter path to "Instructor" file directory
->

For the **student path**, ITS displays:

Enter path to "Student" file directory
->

Both are followed by the prompt:

Is path correct? [Y/N/Q]:

If you enter **Q**, the program stops.

If you enter **N**, this Step is repeated.

If you enter **Y**, then:

a. If this response is to the **instructor path** prompt, ITS continues with a request for the **student path**.

b. If this request is to the **student path** prompt, ITS continues with Step 14.

14. ITS prompts you (the student) for identification:

Enter name and SSAN:

Name:

ITS asks you to verify identification:

Is name spelled correctly? [Y/N]

If you answer **N**, this request is repeated.

If you answer **Y**, ITS requests your Social Security Number (SSAN):

SSAN: xxx-xx-xxxx

Verify your entry by answering:

Is SSAN correct? [Y/N]

If you enter **N**, SSAN portion of the this Step is repeated.

If you enter **Y**, continue with Step 15.

15. If the student is **new**, ITS displays the following verification step:

Are you a new student? [Y/N]

If you enter **N**, ITS repeats Step 14. Otherwise, if the student is either new, as indicated by a **Y** reply, or has not completed the Experience Questionnaire, as indicated in the student's database, ITS presents the questionnaire.

At the conclusion of the questionnaire, ITS begins the Simulation. If the student is above the base entry level, then the Simulation is used to present a scenario to try and validate the determined level. Otherwise, the Simulation consists of the **Console Checkout** lesson.

Simulation Function

Documentation for the Simulation Function can be found in:

> Systems Research Laboratories, Inc.: "Research and Development Computer Software Report, Delivery Order 0008, Attachment 2, Sequence 1", Contract No. F33615-87-D-0601, September 1990.

Evaluation Function

To execute the Evaluation Function, you must be in a window with access to the VAX. It is also assumed that the student has completed a session with the Simulation. Prior to running the software to evaluate the student's performance, the data captured by the Simulation must be preprocessed so it is time ordered. This is accomplished by executing the following command on the **logger file**.

```
reduce "mindisk 0 f 1 l 6 sim 90 dir [logger file directory string] status"
go
quit
```

Upon completion of the **REDUCE** run, begin the evaluation by entering:

run sdt_eval

Processing continues with the following steps.

1. ITS asks you to specify the location of the output of the previously mentioned **REDUCE** process.

   Enter name of the data file
   Name:

   Enter the catalog/file string of the **Pass 6 logger file** from **REDUCE**. Upon completion, ITS asks you to verify that the file specified is a **REDUCE pass 6** output.

2. ITS asks you to specify the number of WDs tested:

   Enter the number of WDs that were tested:

3. ITS asks you to associate the WDs with a specific console number by answering the following query for the each WD tested:

   Enter console no. of xxx WD:

4. ITS asks you to specify the WD id number for each console that contained a tested WD.

   Enter WD id no. for console x:

   where x is substituted with the appropriate console number.

5. For this Step, ITS displays the following:

   Select skill level for evaluation:

   1) Naive
   2) Novice
   3) Journeyman
   4) Expert
   5) Master

   Selection:

   Enter an appropriate value. At this time, this value is not used. The intent is to provide multiple criteria when evaluating the scenario from a Simulation run.

6. ITS asks for the location of the event script file[3]:

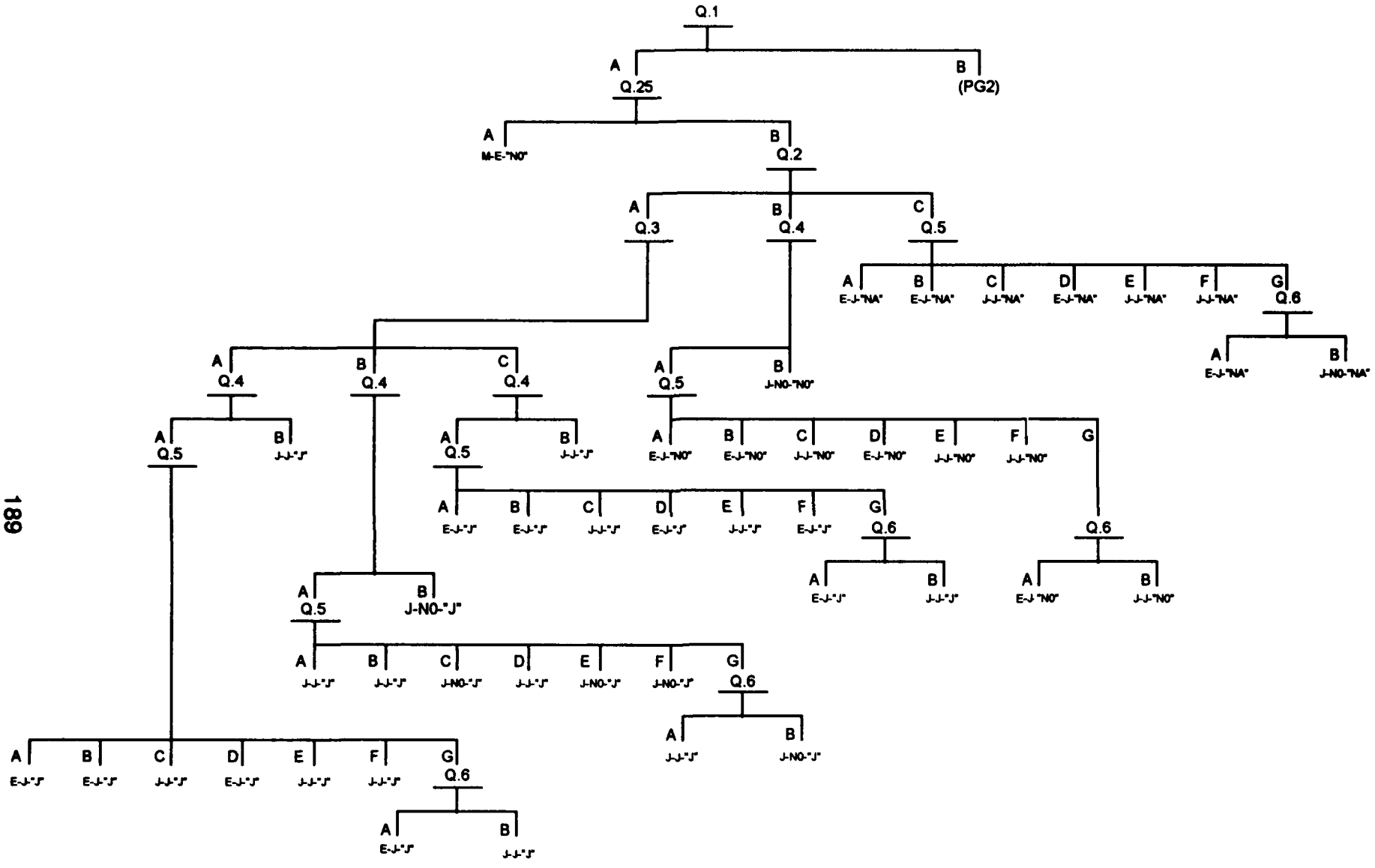
> Enter name of event script file
> Name:

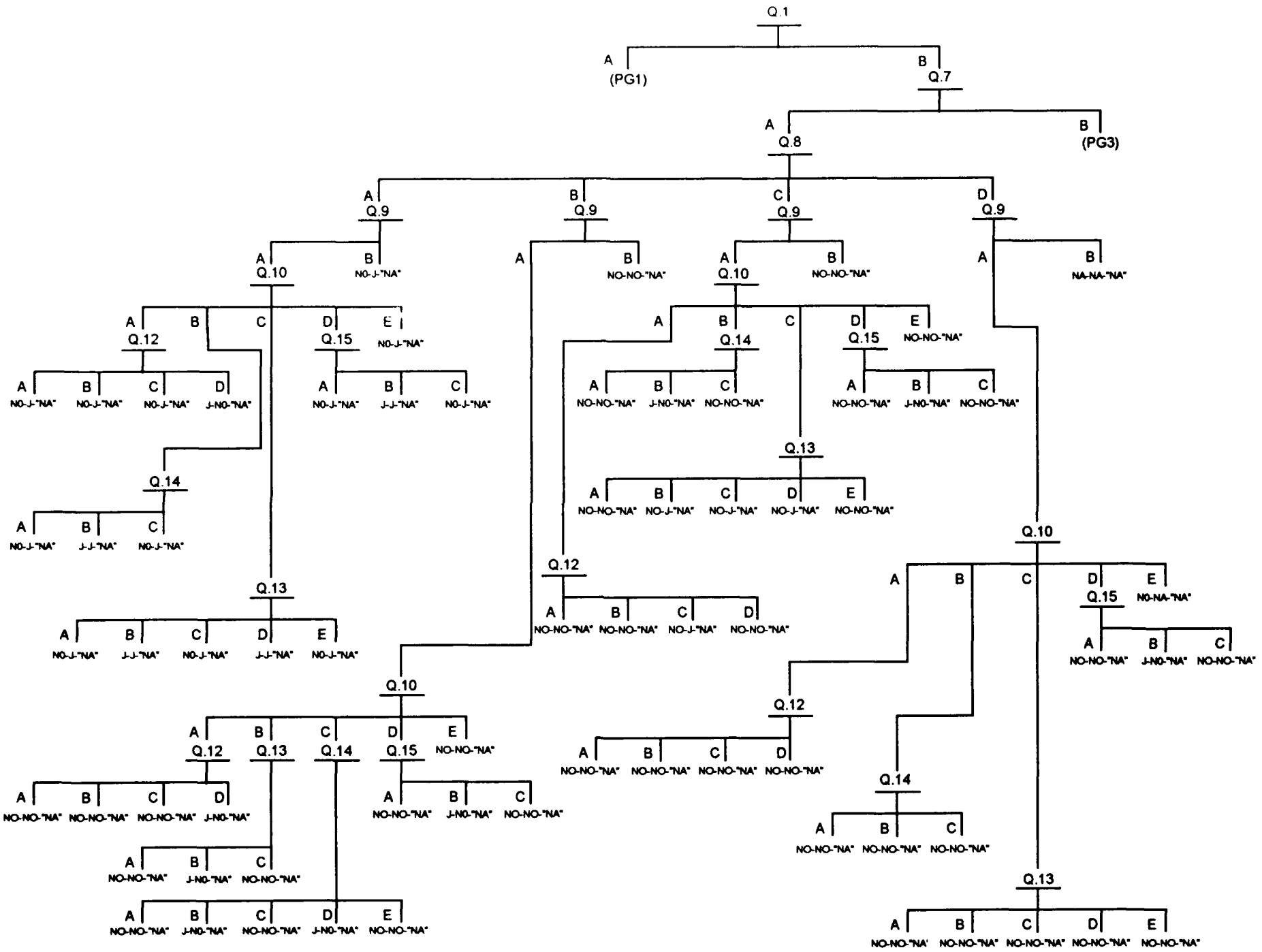
Upon answering the name of the event script file, processing continues until the event script is exhausted. As the absence or presence of each is event is detected, a brief message about the condition is displayed. You must acknowledge each message with the **Enter** key before the program continues. Currently, display of the captured data is limited to the screen. However, recording these data to a file could be easily accomplished.

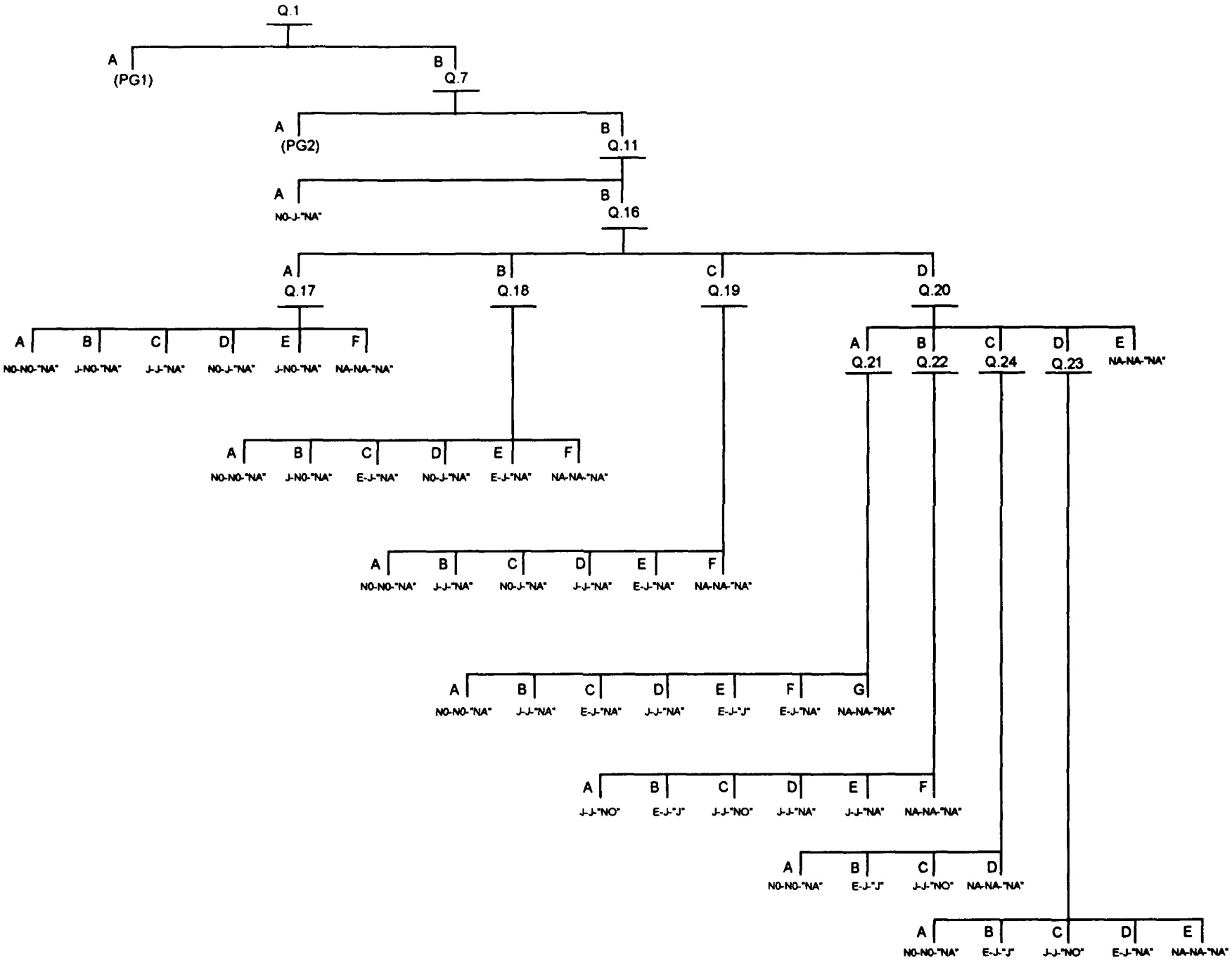
[3] Refer to the section *Implementation* under **DEC VAX 780** for an explanation of the event script file.

Appendix F

Decision Tree


Q.1
A
Q.25
B
(PG2)
A
M-E-"N0"
B
Q.2
A
Q.3
B
Q.4
C
Q.5
A
E-J-"NA"
B
E-J-"NA"
C
J-J-"NA"
D
E-J-"NA"
E
J-J-"NA"
F
J-J-"NA"
G
Q.6
A
E-J-"NA"
B
J-N0-"NA"
A
Q.4
B
Q.4
C
Q.4
A
Q.5
B
J-N0-"N0"
A
Q.5
B
J-J-"J"
A
Q.5
B
J-J-"J"
A
E-J-"N0"
B
E-J-"N0"
C
J-J-"N0"
D
E-J-"N0"
E
J-J-"N0"
F
J-J-"N0"
G
A
E-J-"J"
B
E-J-"J"
C
J-J-"J"
D
E-J-"J"
E
J-J-"J"
F
E-J-"J"
G
Q.6
Q.6
A
E-J-"J"
B
J-J-"J"
A
E-J-"N0"
B
J-J-"N0"
A
Q.5
B
J-N0-"J"
A
J-J-"J"
B
J-J-"J"
C
J-N0-"J"
D
J-J-"J"
E
J-N0-"J"
F
J-N0-"J"
G
Q.6
A
J-J-"J"
B
J-N0-"J"
A
E-J-"J"
B
E-J-"J"
C
J-J-"J"
D
E-J-"J"
E
J-J-"J"
F
J-J-"J"
G
Q.6
A
E-J-"J"
B
J-J-"J"


Q.1
A (PG1)
B
Q.7
A
Q.8
B (PG3)
A Q.9
B Q.9
C Q.9
D Q.9
A Q.10
B N0-J-"NA"
A
B NO-NO-"NA"
A Q.10
B NO-NO-"NA"
A
B NA-NA-"NA"
A B C D E
Q.12
Q.15
N0-J-"NA"
A N0-J-"NA" B N0-J-"NA" C N0-J-"NA" D J-N0-"NA"
A N0-J-"NA" B J-J-"NA" C N0-J-"NA"
A B C D E
Q.14
NO-NO-"NA"
A NO-NO-"NA" B J-N0-"NA" C NO-NO-"NA"
A NO-NO-"NA" B J-N0-"NA" C NO-NO-"NA"
Q.14
A N0-J-"NA" B J-J-"NA" C N0-J-"NA"
Q.13
A N0-J-"NA" B J-J-"NA" C N0-J-"NA" D J-J-"NA" E N0-J-"NA"
Q.13
A NO-NO-"NA" B NO-J-"NA" C NO-J-"NA" D NO-J-"NA" E NO-NO-"NA"
Q.12
A NO-NO-"NA" B NO-NO-"NA" C NO-J-"NA" D NO-NO-"NA"
Q.10
A B C D E
Q.12 Q.13 Q.14 Q.15
NO-NO-"NA"
A NO-NO-"NA" B NO-NO-"NA" C NO-NO-"NA" D J-N0-"NA"
A NO-NO-"NA" B J-N0-"NA" C NO-NO-"NA"
A NO-NO-"NA" B NO-NO-"NA" C NO-NO-"NA"
A NO-NO-"NA" B J-N0-"NA" C NO-NO-"NA" D J-N0-"NA" E NO-NO-"NA"
A B C D E
Q.12 Q.13 Q.14 Q.15
NO-NO-"NA"
A NO-NO-"NA" B NO-NO-"NA" C NO-NO-"NA" D NO-NO-"NA"
A NO-NO-"NA" B NO-NO-"NA" C NO-NO-"NA"
A NO-NO-"NA" B NO-NO-"NA" C NO-NO-"NA"
A NO-NO-"NA" B NO-NO-"NA" C NO-NO-"NA" D NO-NO-"NA" E NO-NO-"NA"
Q.10
A B C D E
Q.15
N0-NA-"NA"
A NO-NO-"NA" B J-N0-"NA" C NO-NO-"NA"
Q.12
A NO-NO-"NA" B NO-NO-"NA" C NO-NO-"NA" D NO-NO-"NA"
Q.14
A NO-NO-"NA" B NO-NO-"NA" C NO-NO-"NA"
Q.13
A NO-NO-"NA" B NO-NO-"NA" C NO-NO-"NA" D NO-NO-"NA" E NO-NO-"NA"


Q.1
A
(PG1)
B
Q.7
A
(PG2)
B
Q.11
A
N0-J-"NA"
B
Q.16
A
Q.17
B
Q.18
C
Q.19
D
Q.20
A
N0-N0-"NA"
B
J-N0-"NA"
C
J-J-"NA"
D
N0-J-"NA"
E
J-N0-"NA"
F
NA-NA-"NA"
A
N0-N0-"NA"
B
J-N0-"NA"
C
E-J-"NA"
D
N0-J-"NA"
E
E-J-"NA"
F
NA-NA-"NA"
A
N0-N0-"NA"
B
J-J-"NA"
C
N0-J-"NA"
D
J-J-"NA"
E
E-J-"NA"
F
NA-NA-"NA"
A
Q.21
B
Q.22
C
Q.24
D
Q.23
E
NA-NA-"NA"
A
N0-N0-"NA"
B
J-J-"NA"
C
E-J-"NA"
D
J-J-"NA"
E
E-J-"J"
F
E-J-"NA"
G
NA-NA-"NA"
A
J-J-"NO"
B
E-J-"J"
C
J-J-"NO"
D
J-J-"NA"
E
J-J-"NA"
F
NA-NA-"NA"
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N0-N0-"NA"
B
E-J-"J"
C
J-J-"NO"
D
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N0-N0-"NA"
B
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C
J-J-"NO"
D
E-J-"NA"
E
NA-NA-"NA"